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A REVIEW OF INTERSTATE POLLUTION. THE POTOMAC RIVER IN THE WASHINGTON METROPOLITAN AREA

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A REVIEW OF INTERSTATE POLLUTION

THE POTOMAC RIVER IN THE WASHINGTON METROPOLITAN AREA

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I

REVIEW OF INTERSTATE POLLUTION OF THE POTOMAC RIVER IN THE WASHINGTON METROPOLITAN AREA

BACKGROUND

Probably no interstate water pollution problem in the nation has been the subject of more studies, articles, talks, and reports than has that of the Potomac River in the Washington Metropolitan Area. The situation has received attention in the Halls of Congress, and by the President of the United States. It has been the subject of lively discussion by residents of the area, in the local press, and on radio and television. It has been noted by countless visitors from the entire nation and from all over the world.

First Comprehensive Study, 1913 - 1914

In 1913-1914 one of the first comprehensive studies of stream pollution in this country was made by the Hygienic Laboratory of the Public Health Service on the Potomac River. At that time the sewered population of the Washington Metropolitan Area was estimated at about 320,000, and practically no sewage treatment was provided. The main river was found to be in reasonably good condition, and it was concluded "that for many years to come the river will have ample oxygen to care for the sewage from the estimated increased population of the vicinity." An exception to the generally satisfactory situation was the stagnant condition of the Washington Channel - Anacostia River area. Much of the offensiveness of this area was attributed to "the storm water discharge, with its content of horse manure, etc." In the vicinity of the main river outfall odor was very slight and "was greatest when the wind came from the Virginia shore, where a soap factory was located." Nevertheless, it was foreseen that "the capacity of the river to dispose of [raw] sewage without nuisance or danger will eventually be overtaxed" and it was recommended that "primary treatment works should be installed in the near future" by the District of Columbia. One of the reasons advanced was "the example in such matters that should be afforded by the national capital."

Since that time the Public Health Service, either independently or in cooperation with other interested agencies, has re-examined the pollution of the Potomac River in the Washington Metropolitan Area on an average of once every ten years. Since 1937 personnel of the District of Columbia Sewage Treatment Plant have maintained a routine river sampling program which has produced an invaluable record of stream conditions.

Although several sewage treatment plants have been provided, the relentless increase in sewered population of the area thus far has outdistanced the improvements that have been made. The history of water quality of the river in the vicinity of Washington has been one of continuing degradation. The national capital has not yet "set the example in such matters" so hopefully proposed in the 1913 report.

Bacteriological Study, 1925

In July and August 1925, the Public Health Service made its second investigation of the pollution of the Potomac River in the vicinity of Washington. The primary purpose of the survey was to determine "whether the use of the river for bathing would expose the bathers to the danger of contracting sewage-borne diseases." Samples were collected from July 7 to July 31. Laboratory determinations were restricted to bacteriological examinations. The report stated that B. coli contamination in 1925 was greater than it had been in September 1913, "as a result of growth of the District and the extension of domestic sewers." It concluded that no section of the river adjacent to the District of Columbia "could be considered free enough from pollution with sewage to permit its use for bathing without a potential danger to such bathers of contracting sewage-borne diseases." The report also noted the problem of storm water discharges and of heavy pollution in the Anacostia River. It recognized the difficulty of obtaining cooperation among the several communities for abatement of pollution, in the absence of adequate pollution control laws, but suggested that much could be accomplished in reduction of pollution by extension of main intercepting sewers of the District of Columbia and by either primary treatment of District sewage or extension downstream of the main outfall sewer.

Study of Disposal of Sewage in the Potomac, 1932

The Public Health Service was directed by a Senate Resolution in 1932 to investigate conditions resulting from the existing method of disposing of sewage from the District of Columbia in the Potomac River. The purposes were to determine whether the disposal constituted a menace to public health and an annoyance to residents, and destroyed or rendered oysters unfit for human consumption, and to determine the estimated cost of a more suitable method of disposal. By this time the estimated sewered population of the Washington Metropolitan Area had increased to 575,000, or an increase of 80 per cent since 1913. The river was sampled from July 25 through September 14. The effects of pollution had increased markedly since the 1913-1914 survey. The bacterial contamination was judged to render the river unsuitable for bathing from Three Sisters Island to Fort Washington. "At the sewer outlets (dissolved oxygen) saturation was 42 per cent in 1932 as compared to 61 per cent in 1913." On some days in 1932 the "dissolved oxygen was depleted at the sewer outlets and approached depletion at Giesboro Point and in the lower Anacostia River." There was "an area between Giesboro Point and Fort Foote in which the average oxygen saturation was below 50 per cent." The dissolved oxygen was so reduced that "fish life can no longer be supported within this area." In anticipation of the normal increase in sewage load in the future it was predicted that "conditions near the sewer outlets may actually be productive of nuisances." For the first time the situation was described as critical. The report concluded that the District of Columbia should take steps to provide treatment "if it should be desirable to prevent the development of nuisances and make the river suitable

for bathing and other recreational purposes and capable of supporting fish life during the summer." Primary treatment was considered adequate for the immediate future, but it was suggested that the plant design incorporate provisions for subsequent addition of secondary treatment.

In 1937 the District of Columbia completed a primary sewage treatment plant and placed it in operation. Treatment plants were completed by several Maryland and Virginia communities in the Washington Metropolitan Area during the thirties.

Low Stream Flow Augmentation Study, 1944

In 1944 the Public Health Service completed a report for the Corps of Engineers on estimated benefits to water supply and waste disposal in the Potomac River Basin that would result from low stream flow augmentation through a series of impoundments proposed by the Corps. Conclusions regarding sewage disposal in the Washington area were based principally on results of river sampling by the District of Columbia sewage treatment plant personnel from 1937 through 1943. Sewered population in the Washington area had doubled since 1932, and stood at an estimated 1,149,000 in 1943. This was an increase of 250 per cent since 1913. Sewage treatment in the District of Columbia, the Washington Suburban Sanitary District (Maryland) and Arlington County, Virginia reduced the sewage discharged to the river in the area in 1943 to an estimated population equivalent of 781,000. Thus in spite of many millions of dollars spent for sewage treatment the river was receiving a 36 per cent greater load of sewage in 1943 than it had in 1932.

The increased sewage load was reflected in decreased dissolved oxygen content of the river water. The 1944 report noted that a minimum dissolved oxygen of 0.3 ppm had been found in the tidal estuary opposite Washington, and "that the average of the lowest individual results obtained during the past six years is 2.4 parts per million." It concluded that "the present treatment of sewage at Washington, D. C., and vicinity would be considered inadequate and that secondary treatment through the six summer months (May through October) is required to correct objectionable conditions."

Interstate Commission Study, 1954

In 1954 the Interstate Commission on the Potomac River Basin published an excellent report on water pollution in the Washington Metropolitan Area. The Public Health Service, as well as many other agencies, cooperated in the preparation of this report. This publication deals in a comprehensive manner with all facets of the problem, including all sources of wastes, the effects on river water quality through 1951, present and future water uses, water quality objectives for various sections of the river, and pollution control measures needed, with a recommended pollution control program and estimated costs of needed improvements.

It was estimated that the sewered population of the Metropolitan

Area had increased to 1,540,000 by 1952, a 34 per cent increase since 1943. The estimated population equivalent of the sewage discharged to the river had increased to 1,135,000, for an increase of 45 per cent since 1943.

The continuing increase in sewage discharged to the river was reflected in continuing reduction in water quality. The Interstate Commission report succinctly summarizes the condition of the Potomac in the Washington area. The river "approaching the District of Columbia is a reasonably clean stream" but periodically is "higher in bacteria than desirable. Pollution mounts rapidly in the Roosevelt Island area and below, resulting from combined sewer overflows, the discharge from the Anacostia River" and sewage from the District of Columbia and the three Virginia jurisdictions across the river. "Dissolved oxygen is practically depleted at times, the most probable number of coliforms ranges as high as 500,000 per 100 ml., and unsightly, malodorous conditions result." The "unsightly conditions" included visible evidence of sewage pollution on the District side of the river in the vicinity of 27th and G streets and the Water Gate, where overloaded interceptors discharged undetermined quantities of raw sewage. Similar visible evidence of sewage existed in the slack water of Four Mile Run below the outlets of Alexandria and Arlington County sewage. Gas bubbles from sewage sludge deposits rose to the surface over wide expanses of the river. The resulting "malodorous condition" was notably prevalent in the section from Roosevelt Island opposite the mouth of Rock Creek, to a short distance below the mouth of Four Mile Run.

The foregoing brief history of the losing struggle against pollution of the Potomac River in the Washington Metropolitan Area is taken from only five reports selected from the mass of available written material on the problem that was reviewed and abstracted. The most recent of the five, that of the Interstate Commission on the Potomac River Basin, covers the problem so thoroughly that nothing would be gained at this time by adding another lengthy report to the already profuse store of publications. It is necessary only to bring the salient features of the Interstate Commission report up to date.

PRESENT CONDITIONS

Sources of Pollution

Sewage

The Potomac River in the Washington Metropolitan Area receives sewage from five major areas. These are the District of Columbia, the Washington Suburban Sanitary District (Maryland), Alexandria, Virginia, and Arlington and Fairfax counties (Virginia).

During the week of April 28, 1957, officials responsible for sewage disposal in the five areas were interviewed by representatives of

the Public Health Service. Through the courteous cooperation of these officials information was obtained on the current status of sewage disposal. Data on sewered populations were provided. Sewage treatment plants were visited and treatment practices were observed. Plant operation records were reviewed and abstracted for data on sewage loads entering the plants and discharging to the receiving waters. Locations of points of sewage discharge were determined. These included points at which both treated sewage from the plants and untreated sewage from storm water overflows and from interceptor, pumping station and treatment plant bypasses enter the receiving waters. Available data on quality of the receiving waters were obtained.

Figure I presents: the locations of the principal sewage treatment plants, their points of discharge and the general areas of raw sewage discharge from the numerous overflows and bypasses.

Table I summarizes: data on population equivalents; types of sewage treatment; raw and treated sewage loads; reductions accomplished by treatment plants; and percentages of the total load of pollution discharged to the receiving waters from the individual sources.

The present total raw sewage population equivalent is estimated to be 1,678,000 which is a 9.0 per cent increase since the 1952 estimate of the Interstate Commission. Treatment plants reduced this to an estimated population equivalent of 1,143,000. This population equivalent is based on normal performance of the existing sewage treatment plants. Actually, during the week of April 28, the District of Columbia Blue Plains plant and the Fairfax County Westgate plant were not operating normally. The abnormal operation permitted an estimated additional population equivalent of 142,000 to be discharged to the river at that time. The population equivalent of 1,143,000 represents 32 per cent over-all reduction of the raw sewage originating in the Washington Metropolitan Area.

Figure XVIII shows the increases in sewered population and sewage discharged to receiving waters since 1913.

The population equivalent of the sewage discharged to the receiving waters is about one per cent greater than it was in 1952. Thus, the over-all benefits accruing from installation of sewage treatment plants by the city of Alexandria and by Arlington and Fairfax counties during the past five years have been negated by the inexorable increase in sewered population of the metropolitan area.

This does not in any way detract from the credit due these Virginia areas for their recent contributions toward solution of the over-all problem. Not only have they helped to maintain the status quo with respect to the total treated sewage load discharged to the receiving waters. They also can, by proper operation of the treatment facilities they have provided, improve their share of those localized areas of visual and

olfactory nuisances, caused by raw sewage, which so acutely have called to public attention the serious pollution of the Potomac River.

This does not imply that these Virginia areas, contributing a combined 16 per cent of the sewage load from the Washington Metropolitan Area, have fully solved their sewage disposal problems. The adequacy or inadequacy of the measures taken to date can be determined only within the framework of a unified plan for pollution abatement by the entire Metropolitan area.

The District of Columbia Blue Plains Sewage Treatment Plant contributes 83 per cent of the sewage load discharged to the receiving waters. Of the 1,262,000 sewered population served by the Blue Plains Plant about two-thirds are in the District of Columbia and one-third in the Washington Suburban Sanitary District. With an exceedingly few minor and one major exception the Blue Plains plant receives all of the sewage from the Washington Suburban Sanitary District. The major exception will be discussed subsequently, in connection with overflows of raw sewage.

The Blue Plains plant serves 75 per cent of the sewered population of the Washington Metropolitan Area, but contributes a disproportionate 83 per cent of the total load to the receiving waters. It accomplishes only 25 per cent reduction in the B.O.D. of the raw sewage that it treats, compared to reductions in the range of 35 to 64 per cent accomplished by the three Virginia jurisdictions.

The sewage discharge from the District of Columbia treatment plant is the major sewage load contributing to interstate pollution of the Potomac River in the Washington Metropolitan Area.

Most of the dry weather flow of sewage in the metropolitan area now receives some type of treatment. A discussion of loads discharged by the treatment plants only does not provide a complete picture of the pollution imposed on the Potomac River. There are intermittent discharges of raw sewage that potentially can or actually do occur from all of the sewerage systems involved. These discharges are of several types.

1. Treatment plant bypasses. These are devices, common to most sewage treatment plants, that permit portions of the raw sewage arriving at the plants to be routed around the treatment facilities and to discharge directly to the receiving streams without treatment. These devices normally are used when excessive quantities of sewage arrive at the plants following rains that introduce large quantities of surface runoff to the collection systems. They are provided to prevent hydraulic overloading of treatment facilities, which would be quite costly if designed to handle the occasional large flows involved.

Treatment plant bypasses also may be used when it is not feasible to operate the plants in a normal manner. Reasons for such use include breakdowns in plant equipment and shutdowns for plant repair and maintenance. When possible, maintenance activities should be scheduled for periods when flows in receiving streams are high.

2. Pumping station bypasses. Many sewerage systems require pumps that lift sewage from sewers deep in the ground to sewers at higher elevations through which the sewage flows by gravity to the treatment plants. Pump capacities sometimes are inadequate to handle the entire flow of sewage following rains. At such times portions of the raw sewage flow is allowed to bypass the pumping stations and flow directly to the nearest receiving streams.

3. Storm water overflows. Many of the older cities in this country initially installed combined sewers to accomodate both domestic sewage and all surface water run-off from rainfall. During rains combined sewers carry flows that are many times as great as the normal dry weather flow of domestic sewage alone. Practically all combined sewers are equipped with overflow devices that permit large portions of the storm water flows, including raw sewage, to pass directly to the nearest stream.

4. Interceptor overflows. Intercepting sewers normally are designed to be adequate for increased sewage flows that will result from reasonably anticipated population growths for many years in the future. In areas where population growths exceed reasonable anticipations the interceptors may become overloaded before additional interceptor capacity can be installed. When this occurs overflow devices must be provided, pending installation of relief interceptors, to prevent sewage from backing up into and overflowing from house connections and manholes in streets.

Raw sewage intermittently discharged through bypasses and overflows can cause visual nuisances, due to objectionable floating materials, and olfactory nuisances, due to sludge deposits. These obvious evidences of pollution can cause more adverse public reaction than does a treated sewage discharge that may cause excessive bacterial contamination and badly depleted dissolved oxygen.

Figure I shows general locations of points on the major sewerage systems of the Washington Metropolitan areas where raw sewage discharges can occur.

The newer Arlington and Fairfax county systems have the usual pumping station and treatment plant bypasses. It is reported that they have no combined sewers or overloaded interceptors.

Much of the Alexandria system consists of combined sewers. These have storm water overflows that discharge directly to the Potomac River along the city's waterfront upstream from the mouth of Hunting Creek.

The main interceptor carrying sewage from the Washington Suburban Sanitary District along the Anacostia River to the District of Columbia Blue Plains plant is overloaded. It frequently discharges raw sewage to the Anacostia River through an overflow at Blaine Street.

About one-half of the District of Columbia system consists of combined sewers. These are served by numerous overflow devices along the Potomac River waterfront from about Three Sisters Island to the Memorial Bridge, along the entire length of Washington Channel, and on the Anacostia River and Rock Creek.

The District of Columbia also has overloaded interceptors. Overflows at the Watergate (near Lincoln Memorial) and at 27th and G Streets, in particular, have been cited as points of frequent raw sewage discharge in the past. During the visit to the District of Columbia by Public Health Service personnel during the week of April 28, it was stated that there had been only one dry weather overflow through the 27th and G interceptor overflow since the previous September. Similar improvement in the Watergate interceptor overflow also was reported.

Exact data are not presently available on quantities of raw sewage discharged from the various sources described above. It has been estimated that "about two per cent of the sewage generated in the District [of Columbia] reaches the waters without treatment through the operation of the combined sewers during rains." The District of Columbia has installed continuous flow recorders on its more important sources of raw sewage discharge, and a report on the District's problem is being prepared by a consulting engineer. It is expected that the report will be completed during June of 1957, at which time the first reliable quantitative data on this phase of the situation will be available.

During the week of April 28 about one-third of the raw sewage received at the District of Columbia Blue Plains plant was being bypassed directly to the river without treatment. This was necessitated by work on the sludge digesters. Only one-half of the digesters were in service, and they could handle the sludge from only two-thirds of the raw sewage.

During the visit to the Fairfax County Westgate Sewage Treatment Plant the sludge digester was out of service. All solids that settled in the sedimentation basin were being discarded to the river. The result was that this portion of the Fairfax County sewage was, in effect, receiving no treatment at that time.

Industrial Wastes

The 1954 report of the Interstate Commission on the Potomac River Basin states that "Industrial wastes are a relatively minor problem in this area, with few exceptions, and can be handled to a large extent by appropriate connections to municipal sewer systems." Several cement and sand and gravel companies discharge a total of 40 to 90 tons per day of inert solids to the river. Surface wash and drainage from several stock piles of coal cause discoloration in the Potomac and Anacostia. Most other industrial wastes are from a variety of small manufacturing plants located on small tributary streams. While some of these cause local nuisances and complaints they generally "have little significance with respect to the general pollution load of the main river."

Water Quality

An invaluable record of water quality in the Potomac River since 1937 has been accumulated by personnel of the District of Columbia Blue Plains Sewage Treatment Plant. A routine river sampling and analysis program has been conducted, without break, since September 22, 1937.

Seven sampling stations (Figure I) have been used since the beginning. These covered a 15 mile section of the river, from upstream Three Sisters Island to downstream Fort Washington. The Blue Plains treatment plant outlet discharges at the approximate midpoint of this section. Stations upstream as well as downstream from the outlet show effects of the treatment plant effluent. The upstream effects reflect the impact of tidal action in this section of the Potomac. Rising tides cause water to flow upstream past the plant outlet, carrying the treated sewage with it. When the tide falls the water flows downstream, receiving still more pollution as it again passes the outlet. This may be repeated several times during low stream flow periods. It has been stated that water in this section of the river, carrying its load of pollution, moves downstream so slowly during periods of low flow that the Potomac is more like a lagoon or lake than a river.

In recent years, as the effects of increasing pollution extended farther downstream, the sampling network has been extended by the addition, in 1952, of two more stations to cover the river down to Hallowing Point. This is about 15 miles below the Blue Plains outlet. A third station has been added opposite the outlet.

Samples generally have been collected once or twice monthly during the colder periods of the year. In the more critical periods of higher temperatures and lower stream flows, from March through October, samples generally are collected weekly. Sampling trips usually are made on Wednesdays, between 8:00 AM and 1:00 to 1:30 PM. Principal sampling points are in the river channel at depths of 5 and 25 feet below the water surface except at Three Sisters and Roosevelt islands and above the outfall sewer. At the former two, samples are collected at the 25 foot depth only. At the latter, samples are taken at 5 feet only.

Analytical determinations include temperature, dissolved oxygen, 5-day 20°C biochemical oxygen demand, turbidity, chlorides, bacterial plate counts on agar at 35°C, and most probable numbers of coliform organisms.

Copies of all analytical results through 1956 have kindly been made available by the District of Columbia Department of Sanitary Engineering.

Of the available data, those for coliform organisms and dissolved oxygen have been selected for use in this report as most indicative of the results of sewage pollution of the Potomac River in this area.

Coliform Organisms.

Arithmetic averages of coliform organisms per milliliter have been computed for May through October of each year. Both monthly and summer (May through October) averages have been obtained. The averages for each sampling station from Three Sisters Island to Fort Washington are shown in Figures II through VIII. The averages are expressed in coliforms per ml., rather than in the more commonly used coliforms per 100 ml. The charts include lines, drawn by eye, showing trends in coliform contamination from 1938 through 1956. They include horizontal lines showing the coliform organism objectives suggested in the 1954 report of the Interstate Commission on the Potomac River Basin. Comparable data, where available from previous Public Health Service reports, are shown for the years of 1913, 1925 and 1932.

Averages of summer values for the last three years, 1954-1956, are shown for all sampling stations, except the one opposite the outfall, on Figure XVI. This chart includes the maximum monthly average that occurred during the three summers for each sampling station.

The trends of coliform contamination at the Three Sisters and Roosevelt island stations have not been consistent. At Three Sisters Island most averages have exceeded the monthly median objective of 2,000 per 100 ml. suggested by the Interstate Commission, reaching peaks of 20,000 to 30,000 per 100 ml. in recent years. At Roosevelt Island the averages generally have been below the Commission monthly average objective of 10,000 per 100 ml. However, as recently as 1955, a monthly average has been as high as 250,000 per 100 ml., and many monthly averages have been above the Commission's objective.

The effects of tidal action in carrying pollution upstream from the several points of sewage discharge apparently come into play at Giesboro Point. From this sampling station to Fort Washington there has been a steady trend of increasing bacterial contamination, which shows no signs of reversal, from 1938 to the present. This trend reflects the continued increase over the years in sewage discharged to the river, as shown in Figure XVIII. The upward trend has been most pronounced in the vicinity of the Washington plant outlet, but has been unquestionable at Giesboro Point, Fort Foote, and Fort Washington.

At four of the five stations the coliform contamination has consistently been above the Interstate Commission's suggested objective of 10,000 per 100 ml. Only at Fort Washington has a majority of the averages been below the objective, but even here at least one monthly average each year since 1943 has exceeded the objective.

Figure XVI presents a composite picture of recent bacterial water quality of the Potomac River from Three Sisters Island to Hallowing Point. It is a picture of extreme bacterial contamination which renders the river hazardous to the health of those who use it for any type of recreation that involves contact with the water. At no point can it be considered

safe for swimming. From Giesboro Point to Fort Foote the average coliform contents of the river water have been equivalent roughly to that which would result from dilution of one part of raw sewage with 200 to 1,000 parts of clean water. Maximum monthly averages in this section have been equivalent to contamination that would result from dilution of raw sewage with 30 to 300 parts of clean water. Occasional single samples have yielded results indicative of dilutions as low as one to 10. The hazard of swallowing even a few drops of such highly contaminated water is obvious. This hazard is a real one to all who boat, fish, or even wade in the waters of this section of the Potomac. Some danger exists, in less acute form, from Roosevelt Island to Giesboro Point and from Fort Foote to Hallowing Point.

Dissolved Oxygen

The dissolved oxygen data in the records of the Blue Plains plant have been analyzed for both trends in effects of organic sewage pollution and for recent effects of such pollution.

The minimum consecutive 28 day dissolved oxygen average for each year since 1938 has been computed. Generally this involved four samples taken at weekly intervals, but for two or three years only two results obtained at biweekly intervals were available. The minimum values obtained are shown in Figures IX through XV. The charts include the minimum single dissolved oxygen value obtained during the 28 day period selected for each yearly minimum average. They incorporate, for comparison, the dissolved oxygen objectives suggested by the Interstate Commission on the Potomac River Basin. Heavy dashed lines, drawn by eye, indicate the trends in dissolved oxygen from 1938 through 1956. Comparable data from previous Public Health Service reports are included.

Figure XVII presents three year averages of the minimum consecutive 28 day dissolved oxygen annual averages, for 1954 through 1956, at all sampling stations from Three Sisters Island to Hallowing Point. It includes the minimum single dissolved oxygen value during the periods involved.

The trends in dissolved oxygen corroborate the evidence of the coliform organism data that the quality of water in most of this section of the Potomac has undergone continuing degradation. Only at Three Sisters Island has there been no evidence of decreasing dissolved oxygen. Here the minimum average content has remained consistently at a satisfactory level of about 7 ppm. At Roosevelt Island there has been a slight drop, from about 7 to 6 ppm, but the minimum dissolved oxygen level here has been satisfactory.

From Giesboro Point to Fort Foote the reduction in minimum average dissolved oxygen has been quite marked, from the range of 4 to 5 ppm in 1938 to a range of 1 to 3 ppm at the four sampling stations. Single minimum values in this section have been in the low range of 0.1 to 0.6 ppm. The river is threatened with septic conditions over large areas

that would cause a more severe odor nuisance than any that has been encountered to date.

At Fort Washington there has been a slight drop in dissolved oxygen from a range of 4 to 5 ppm to about 4 ppm.

The curve of three year minimum averages at all stations (Figure XVII) gives a composite picture of recent low dissolved oxygen levels. In 1955, the worst of the three years, minimum consecutive 28 day averages in the zone of heaviest pollution were 0.5 to 1.2 ppm lower than were the three year averages. Minimum values on single samples in this section were in the range of 0.2 to 0.6 ppm.

Only in the Three Sisters Island to Roosevelt Island section of the river did the dissolved oxygen meet the objectives of the Interstate Commission on the Potomac River Basin. These objectives have been agreed upon as reasonable by all agencies involved, with one exception. District of Columbia representatives have felt that the dissolved oxygen objectives are somewhat stringent.

A six mile section of the Potomac River, from about Giesboro Point to Fort Foote, extending 2.5 miles above and 3.5 miles below the Blue Plains Sewage Treatment Plant outlet, is approaching a disastrous condition of dissolved oxygen depletion. Under recent conditions only the coarsest and most pollution resistant fish could be expected to inhabit this section. For at least 20 miles the dissolved oxygen has been below the minimum of 5.0 ppm usually considered suitable for propagation of a variety of desirable fishes.

A summer of usually prolonged and severe low flow and high temperature conditions might well cause the dissolved oxygen in the vicinity of the Blue Plains plant to go to total depletion, with resulting odor due to septicity and destruction of such fish as inhabit the waters of the area.

The severe effects of pollution indicated by coliform organism and dissolved oxygen content of the Potomac River in the Washington area have resulted principally from sewage discharged from the outlets of the major treatment plants of the Washington Metropolitan Area.

Public Nuisances

Most of the dry weather flow of sewage in the Washington area now receives treatment that should minimize floating sewage solids and sludge deposits. However, substantial areas of localized nuisances result principally from raw sewage discharged from storm sewers and overloaded interceptors.

The areas that have caused most frequent objections are the waterfront opposite the Lincoln Memorial, the Washington Channel, the Anacostia River, and the backwater areas of Four Mile Run and Hunting Creek.

District of Columbia storm sewers and overloaded interceptors have largely been responsible for the nuisances near the Lincoln Memorial and along the Washington Channel.

Washington Suburban Sanitary District sewage has been the principal offender in the Anacostia River, but this condition has been much improved by the recent routing of the Sanitary District sewage to the District of Columbia treatment plant. Only the overloaded interceptor that overflows to the Anacostia at Blaine Street still poses a problem there.

The installation and operation of the Virginia communities' sewage treatment plants have done much to improve the Four Mile Run and Hunting Creek areas. Floating solids no longer should cause objection in these areas. Sewage from the Arlington primary treatment plant still was causing odor in the backwater from the river at the mouth of Four Mile Run during the week of April 28. There was some odor in Hunting Creek immediately below the point of discharge from the Alexandria intermediate treatment plant.

Similar nuisance conditions undoubtedly will occur along the Alexandria waterfront from time to time because of storm water overflows there.

The several areas of nuisance constitute the major factor that has focussed the public's attention on the pollution problem, and has engendered such an insistent demand for cleaning up the Potomac River. The floating sewage solids affront the sight, and the sewage sludge deposits cause odors offensive to the sense of smell. There are literally thousands, who can attest to the fact that these localized nuisances have caused sections of the Potomac in the Washington area to be extremely objectionable. Equally certain is the fact that, no matter what sewage treatment is provided at existing plant sites, the public will not accept the Potomac as a clean river until the raw sewage overflow nuisances are eliminated.

Interference With Water Uses

Water uses with which existing pollution of the Potomac River interferes in the Washington Metropolitan Area have been mentioned in connection with the various effects of pollution on water quality. These uses are summarized in this section.

The section of the river involved in this report does not serve as a source of public water supply, and is not likely to be used for this purpose in the foreseeable future. The District of Columbia water supply is drawn from the Potomac above Great Falls, far upstream from the river section under discussion.

The river is an important recreational asset to residents of the area and to visitors. Its recreational use takes a variety of forms.

Its scenic value is great, but is minimized when the viewer detects a sewage or septic odor from its waters, or notes objectionable floating matter on its surface in those localized areas where raw sewage overflows occur.

Many areas along the waterfront are used for public recreation. The waterfront uses involve picnicking, fishing, sight seeing, sports and commercial eating establishments. The pleasure from these uses can be increased by proximity to a body of clean water. Along the Potomac in the Washington area the pleasure often is minimized by odor and unsightly floating material from raw sewage overflows. Any direct contact with the water incidental to the waterfront uses involves a potential health hazard because of contamination by sewage bacteria. The hazard exists to some degree from Roosevelt Island to Hallowing Point and is most acute from Giesboro Point to Fort Foote. Fish taken from this section carry contamination that presents a hazard to the fishermen and to those who eat the fish unless they are thoroughly cleaned and cooked.

Use of the river for water sports is important to the area. Bacterial contamination renders the river hazardous for swimming at least from Three Sisters Island to Hallowing Point, and probably even farther downstream. There is relatively little swimming in the Potomac in the immediate vicinity of Washington because of the general knowledge of its polluted condition and the generally unsuitable physical characteristics of the river bottom. There is little probability that the river can be made suitable for swimming between Roosevelt Island and Fort Washington regardless of any improvements made in sewage disposal. Proper treatment of all sewage in the area should assure water quality safe for swimming downstream from Fort Washington. The river is widely used for pleasure boating. This use inevitably involves some direct contact with the water, and possibly poses the single greatest hazard to health resulting from excessive contamination of the river by sewage bacteria.

The river is used as a source of water supply by several industries in the area. There is no known case of interference by pollution with the industrial processes. Those workers who come in direct contact with the untreated water are subjected to the health hazards described in connection with recreational uses.

Navigation is an important use of the river. The sewage pollution presents no interference to navigation as such, but exposes those engaged in this occupation to the health hazards of direct contact with the water.

A major public nuisance resulting from the pollution does not involve use of the water, but is probably the single major factor in the public's awareness of the polluted condition of the Potomac. This is the odor which, at certain times of the year, is so obvious to those whose pursuits bring them in the general vicinity of the river in the Washington Metropolitan Area. Raw sewage overflows from storm sewers

and overloaded interceptors, rather than treated sewage effluents, are primarily responsible for this nuisance.

The Potomac plays an essential role in the welfare of the metropolitan area through its capacity to receive and carry away liquid wastes. Employment of this capacity is a proper use of the river provided that the wastes receive such treatment as is necessary to avoid undue interference with other reasonable and essential uses. In the Washington Metropolitan Area this use has become an abuse through failure of sewage treatment to keep pace with growth in sewered population.

SUMMARY

The history of interstate pollution of the Potomac River in the Washington Metropolitan Area has been one of continuing degradation of water quality since the first comprhensive survey of pollution in 1913-1914.

The degradation has resulted from failure to counterbalance the effects of a rapidly expanding sewered population by timely provision of sewage treatment facilities. The 1957 sewered population equivalent of 1,678,000 is five times the 320,000 population of 1913. Present sewage treatment reduces the strength of the raw sewage only 32 per cent. The treated sewage load to the river in 1957 is equivalent to the untreated sewage from 1,143,000 persons. This is nearly four times the load in 1913.

The effects of the unchecked increase in sewage load discharged to the Potomac are reflected by bacterial contamination and dissolved oxygen depletion of the river water from 1938 through 1956. There are increasing trends in coliform organisms from Giesboro Point to Fort Washington, and decreasing trends in dissolved oxygen from Roosevelt Island to Fort Washington.

Bacterial contamination from sewage presents a health hazard to anyone swimming in the river throughout the entire 23 mile section from Three Sisters Island to Hallowing Point. There is a health hazard even in casual contact with the water, such as that inherent in wading, fishing and boating, from Roosevelt Island to Marshall Hall. This hazard is acute from Giesboro Point to Fort Foote.

The minimum average dissolved oxygen for 1954 through 1956 consistently falls below 4.0 parts per million in an 11 mile section from above Giesboro Point to Fort Washington. In the vicinity of the District of Columbia sewer outlet the minimum average falls to the very low value of 2.4 parts per million. Several single samples have yielded extremely critical values of only a few tenths of a part per million. Only at Three Sisters and Roosevelt islands was the dissolved oxygen at a satisfactory level. These points are above the effects of pollution carried

upstream along the Washington waterfront by tidal action. If the present trend of increasing pollution continues it will be a matter of only a few years until total oxygen depletion, with its attendant septic odors and destruction of fish, will occur during periods of high temperature and low stream flow. Even now a severe summer of prolonged low stream flow and high temperature might culminate in this disastrous condition. At present only coarse and pollution resistant fishes, such as carp and catfish, can inhabit these waters from Giesboro Point to Fort Foote. Most game fish can be expected to avoid the river as far downstream as Hallowing Point.

The sewage that causes this interstate pollution originates in the following major areas.

Area	Percent of Total Sewered Population Equivalent	Percent of Total Load To River
Alexandria, Virginia	6.4	3.3
Arlington County, Virginia	10.6	9.0
District of Columbia	75.3	80.8
(Washington Suburban Sanitary District, Maryland)*	(25.6)	(28.2)
Fairfax County, Virginia	5.2	3.3

* Sewage treated in District of Columbia plant.

These figures speak for themselves. The District of Columbia discharges more than four-fifths of the total load of sewage pollution to the river. The three Virginia communities combined contribute less than one-sixth of the total pollution load.

Another, and perhaps equally important, problem is that of raw sewage overflows. Areas where storm water overflows occur are along the District of Columbia waterfront from Three Sisters Island to Memorial Bridge, along Rock Creek and Anacostia River, and along the Alexandria waterfront upstream from the mouth of Hunting Creek.

The District of Columbia also has overloaded interceptors. Two overflows, at 27th and G. Streets and the Watergate, in the vicinity of the Lincoln Memorial, have been reported to discharge raw sewage frequently in the past. More recent information is that overflow here is rare during dry weather. The interceptor carrying Washington Suburban Sanitary District sewage along the Anacostia River to the District of Columbia sewage treatment plant is overloaded, and discharges raw sewage to the Anacostia at Blaine Street.

The areas where raw sewage discharges are the foci of public

complaints regarding pollution in the vicinity of Washington. In these areas the floating material in raw sewage collects on the surface of the water to offend the aesthetic senses. The settleable solids sink to the bottom to accumulate as sludge deposits. These deposits undergo septic decomposition to give off the rotten egg odor of hydrogen sulfide.

Areas of the Potomac that have been notorious for unsightly and malodorous conditions are in the vicinity of Lincoln Memorial and the Washington Channel. The lower Anacostia also has been an offender of long standing. The backwaters of Four Mile Run and Hunting Creek were little more than septic pools before the Virginia communities provided sewage treatment facilities. There has been improvement in these areas, but only recently odor was noted at the mouth of Four Mile Run below the Arlington treatment plant.

Much effort and money has been expended on sewage treatment in the Washington Metropolitan Area. Commendable progress has been and is being made. However, it is evident that pollution of the Potomac River in the ~~Washington Metropolitan~~ Area constitutes pollution of interstate waters subject to abatement under the Federal Water Pollution Control Act as such pollution endangers the health and welfare of persons in states other than those in which the discharges contributing to such pollution originates.

Table I

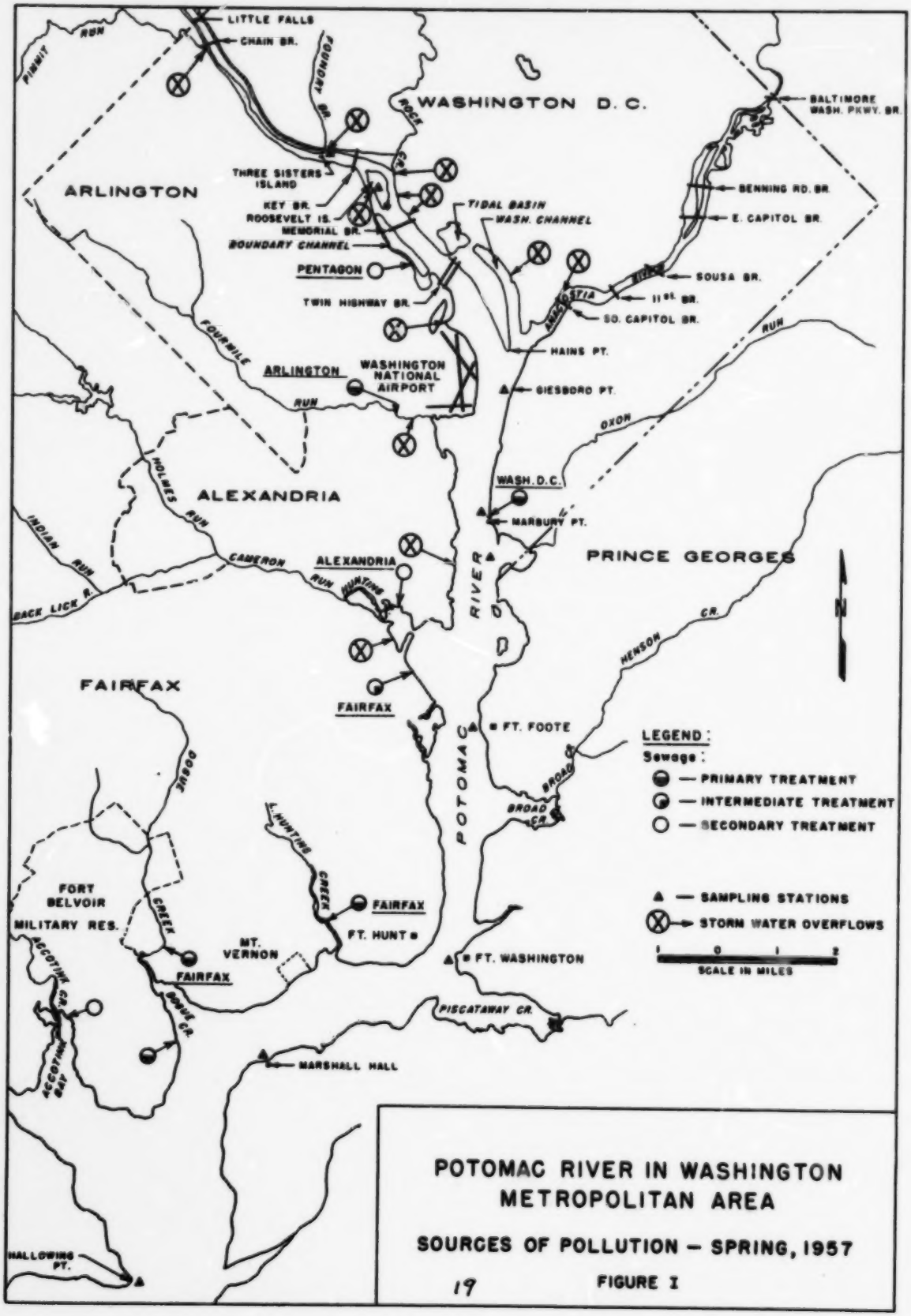
Sources of Pollution Discharged to Potomac River
in the Washington, D. C. Metropolitan Area
Spring 1957

DRY WEATHER FLOWS

Source	Location on Potomac	BOD, lbs/day			Population* Equivalent		% Total Load to Potomac	
		Raw	Effluent	% Removal	Raw	Effluent	Pop. Served	Treated Effluent
Alexandria	Hunting Creek	19,330	6,950	64.0	107,370	38,610	6.4	3.3
Arlington	Fourmile Run	32,120	18,550	42.2	178,450	103,070	10.6	9.0
Fairfax								
Westgate Plant	Hunting Creek	13,110	5,780	55.9	(72,810)	(32,140)		
Pimmit Run	Pimmit Run, 3 Mi. Up.			35.9	(8,370)	(1,460)		
Little Hunting Creek	Little Hunting Creek			35	(3,900)	(2,540)		
Dogue Creek	Dogue Creek			35	(2,250)	(1,460)		
			Total Fairfax		87,330	37,600	5.2	3.3
District of Columbia	Marbury Pt.	227,200	170,300	25.0	1,262,100	946,020	75.3	82.8
D. C.	(66%)							
Wash. Sub. San. Dist.	(34%)							
Pentagon	Boundary Channel	3,120	330	89.5	17,340	1,820	1.0	0.2
Ft. Belvoir	Dogue Creek	-	-	30**	25,000**	16,000**	1.5	1.4
				Total	1,677,590	1,143,120	100.0	100.0

* Based on 0.18 lbs. BOD per capita
** Estimated

8/



POTOMAC RIVER IN WASHINGTON METROPOLITAN AREA

SOURCES OF POLLUTION – SPRING, 1957

FIGURE 1

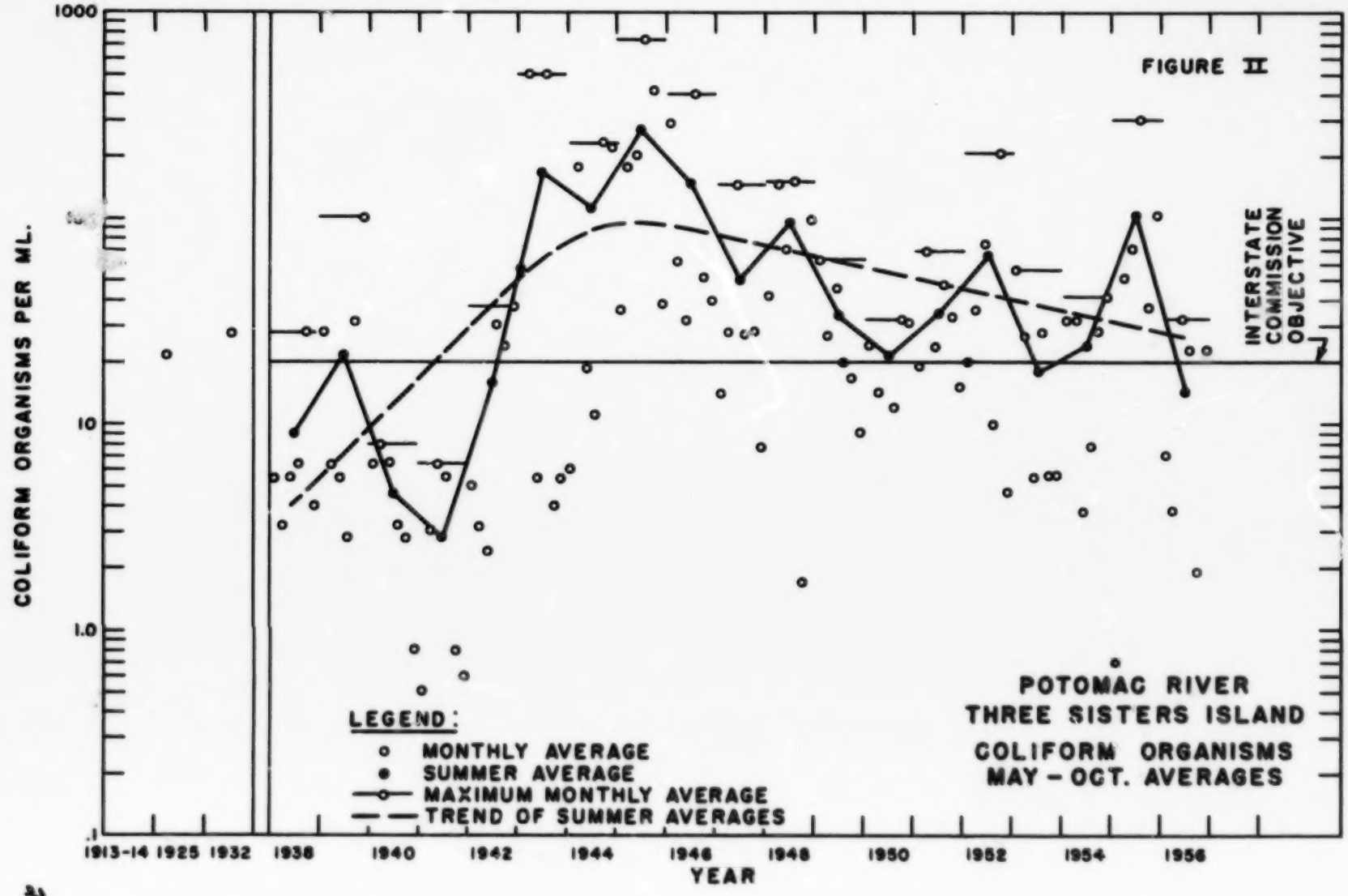
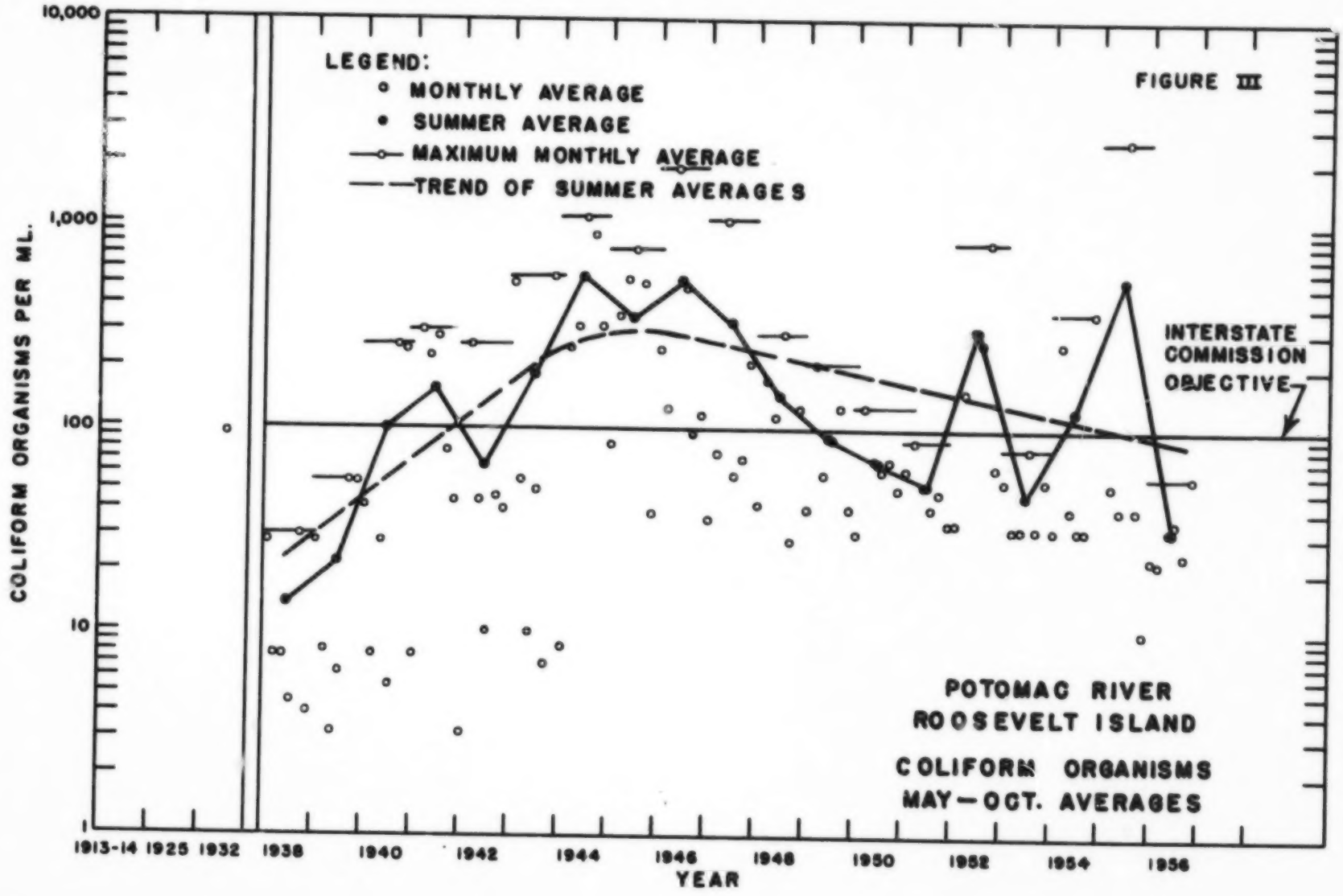
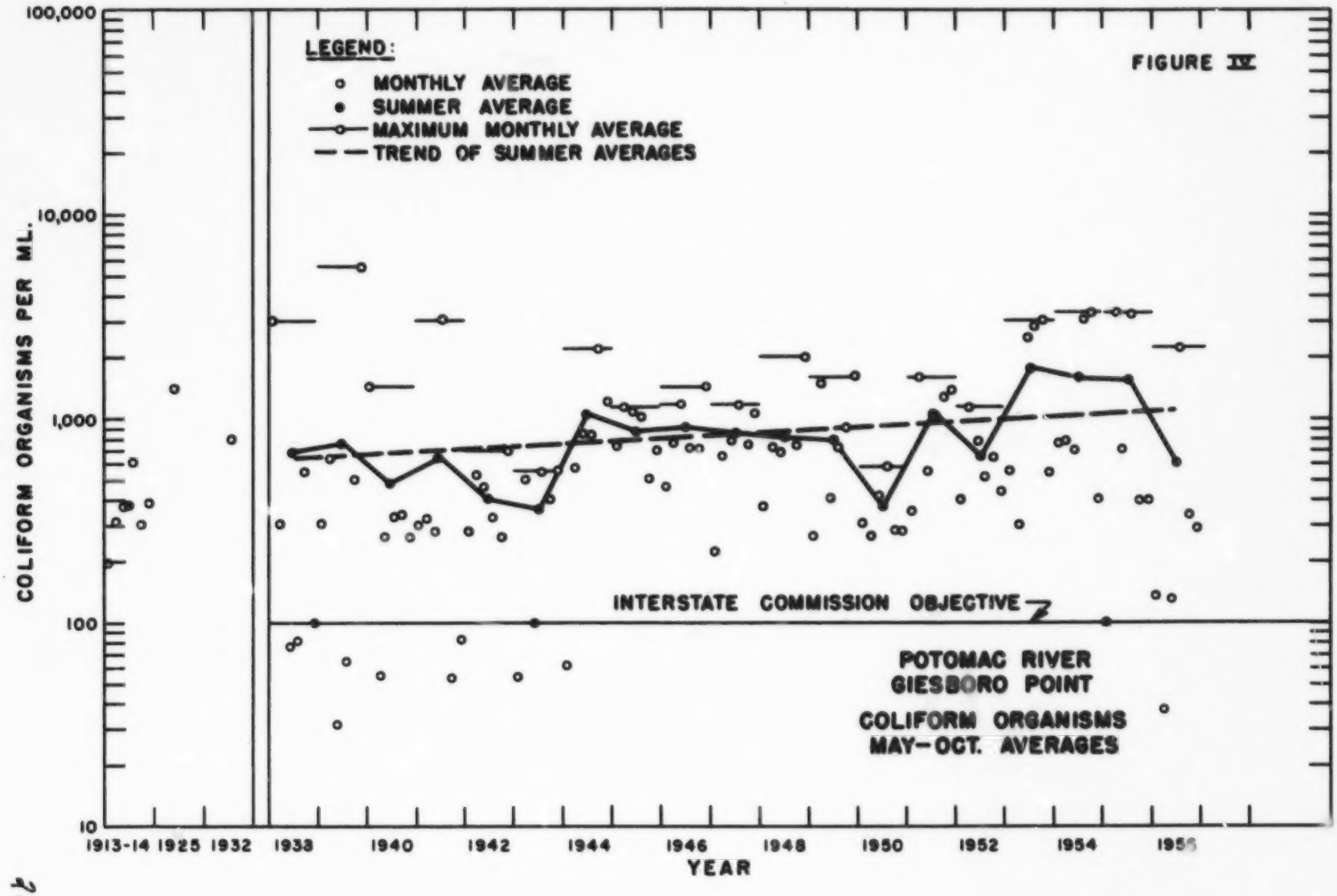
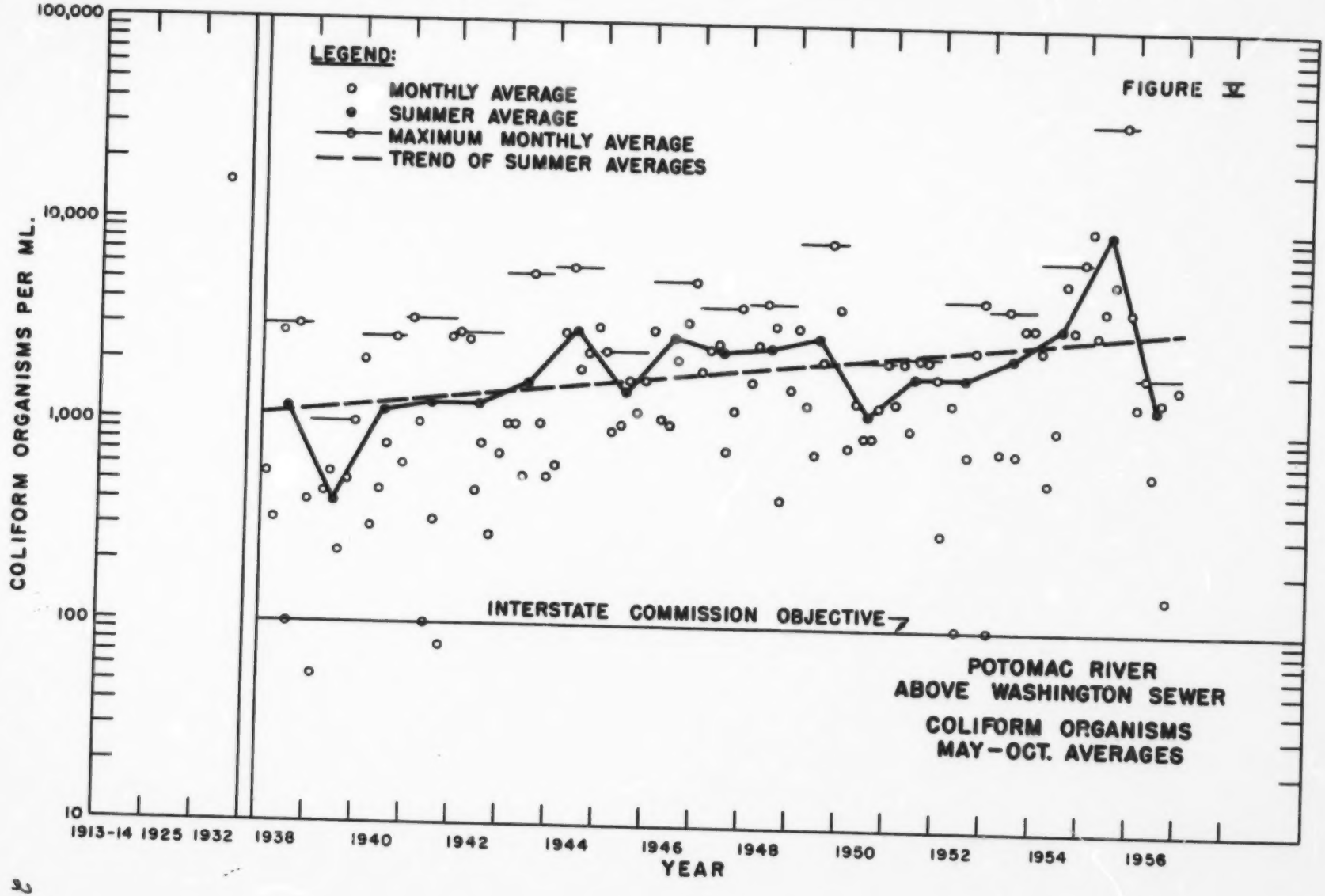
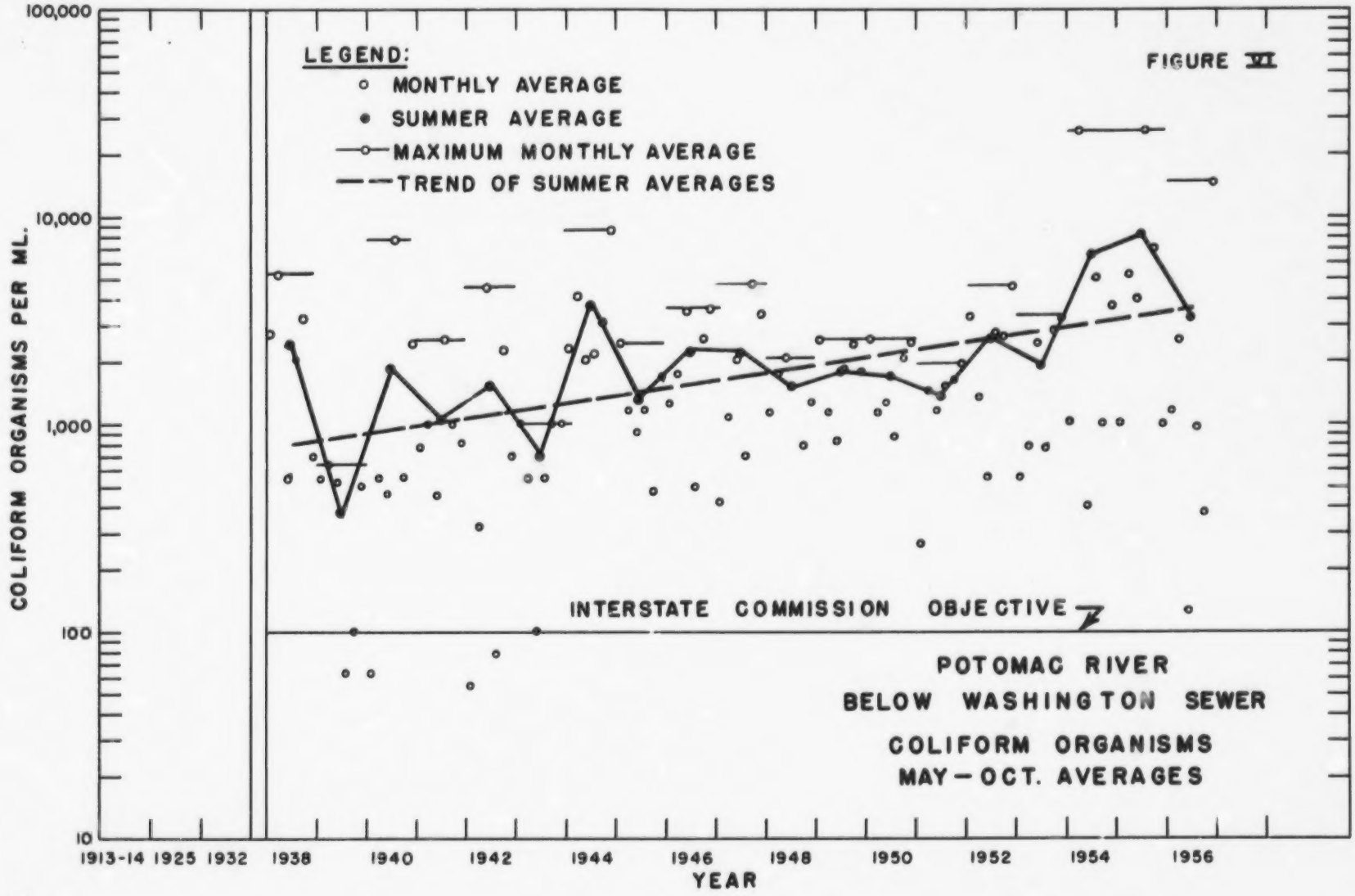


FIGURE II
COLIFORM ORGANISMS PER ML.
1000
10
1.0
.1
1913-14
1925
1932
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR
INTERSTATE COMMISSION OBJECTIVE
LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MAXIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
POTOMAC RIVER
THREE SISTERS ISLAND
COLIFORM ORGANISMS
MAY - OCT. AVERAGES


LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MAXIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
FIGURE III
INTERSTATE COMMISSION OBJECTIVE
POTOMAC RIVER
ROOSEVELT ISLAND
COLIFORM ORGANISMS
MAY—OCT. AVERAGES
COLIFORM ORGANISMS PER ML.
10,000
1,000
100
10
1
1913-14 1925 1932 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956
YEAR


LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MAXIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
FIGURE IV
COLIFORM ORGANISMS PER ML.
100,000
10,000
1,000
100
10
INTERSTATE COMMISSION OBJECTIVE
POTOMAC RIVER
GIESBORO POINT
COLIFORM ORGANISMS
MAY-OCT. AVERAGES
1913-14 1925 1932 1933 1940 1942 1944 1946 1948 1950 1952 1954 1956
YEAR


LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MAXIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
FIGURE V
100,000
10,000
1,000
100
10
COLIFORM ORGANISMS PER ML.
INTERSTATE COMMISSION OBJECTIVE
POTOMAC RIVER
ABOVE WASHINGTON SEWER
COLIFORM ORGANISMS
MAY-OCT. AVERAGES
1913-14
1925
1932
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR


LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MAXIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
FIGURE VI
INTERSTATE COMMISSION OBJECTIVE
POTOMAC RIVER
BELOW WASHINGTON SEWER
COLIFORM ORGANISMS
MAY – OCT. AVERAGES
COLIFORM ORGANISMS PER ML.
100,000
10,000
1,000
100
10
1913-14 1925 1932 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956
YEAR

27

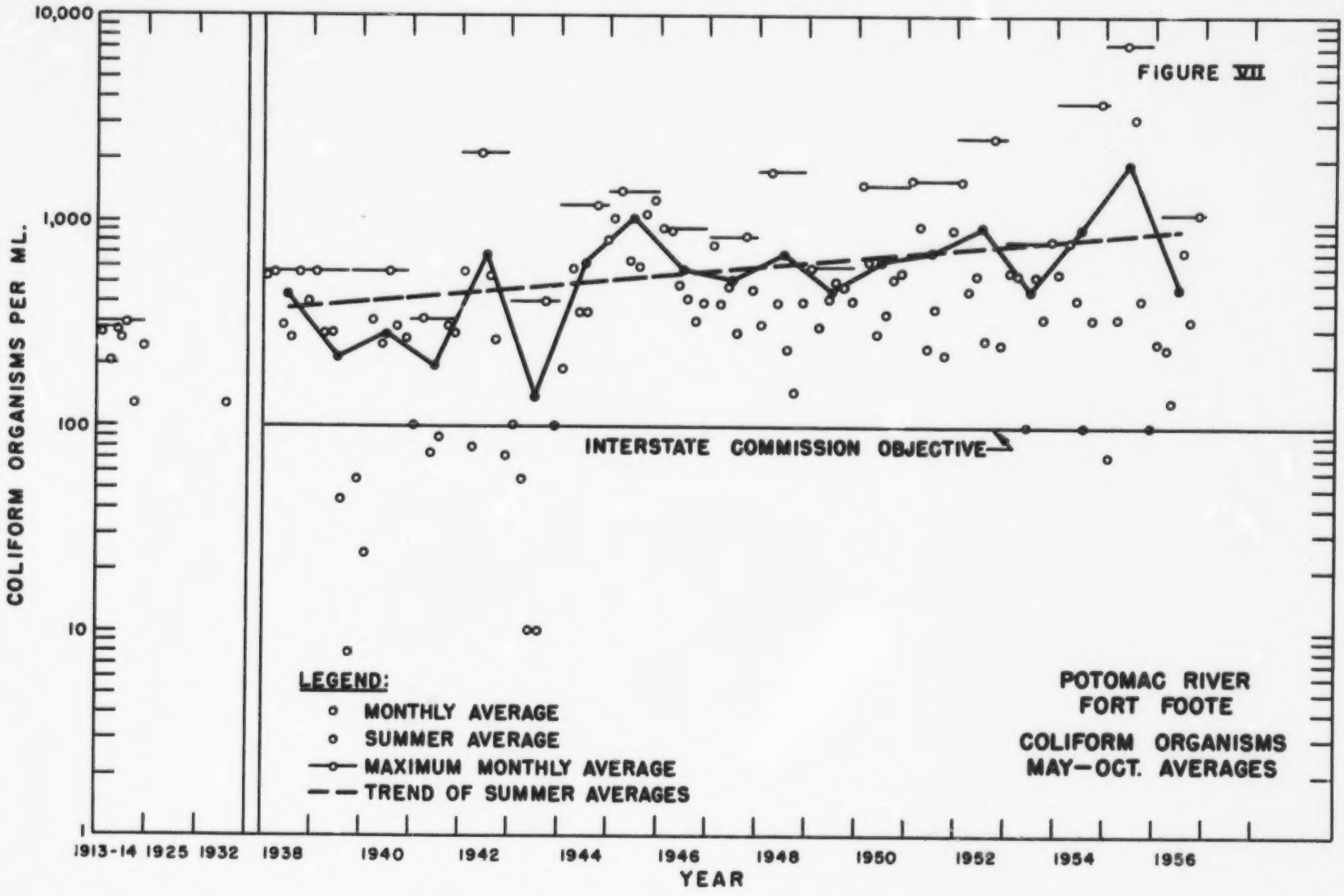


FIGURE VII
10,000
1,000
100
10
1
COLIFORM ORGANISMS PER ML.
INTERSTATE COMMISSION OBJECTIVE
LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MAXIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
POTOMAC RIVER
FORT FOOTE
COLIFORM ORGANISMS
MAY—OCT. AVERAGES
1913-14 1925 1932 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956
YEAR

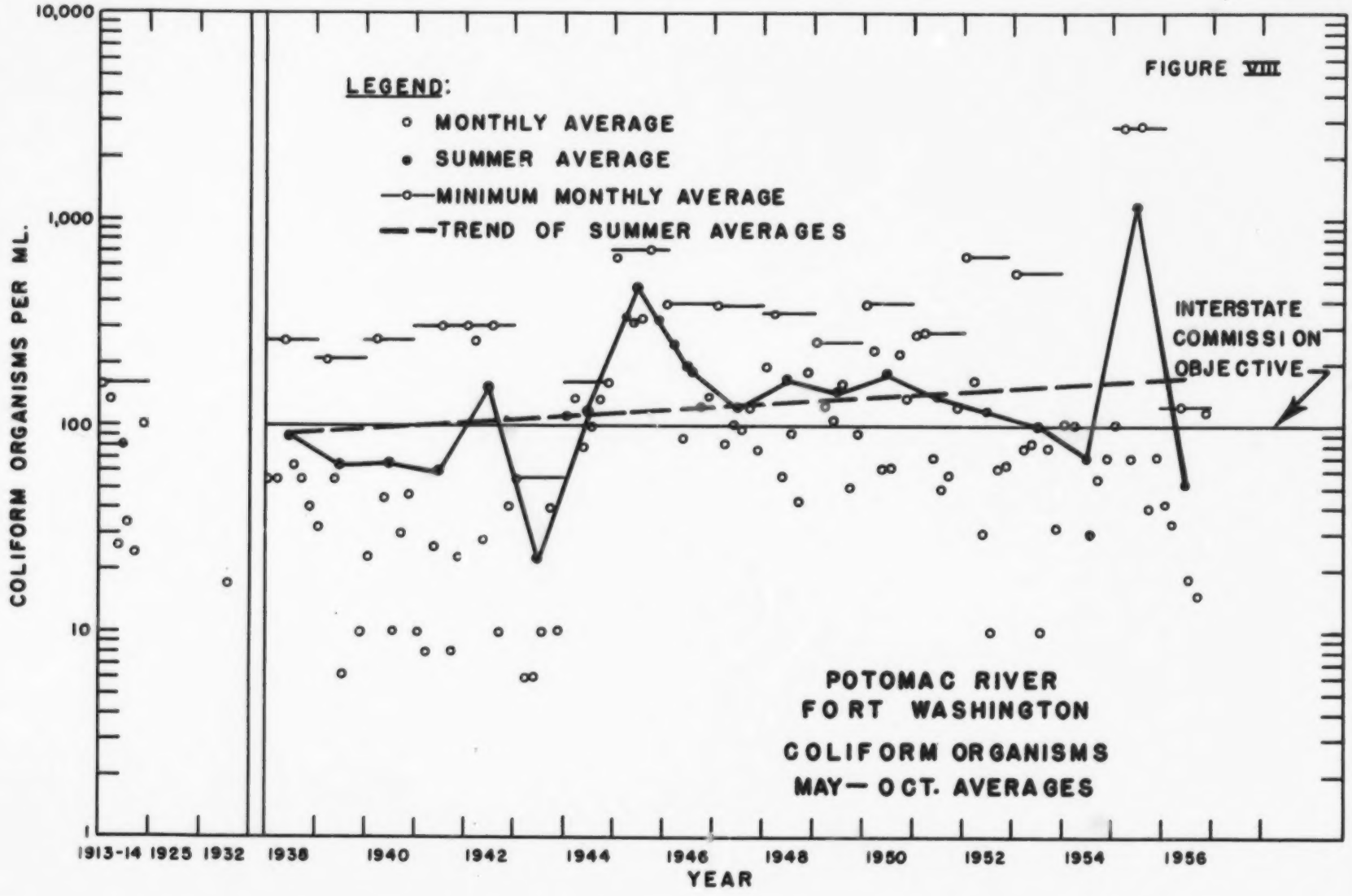


FIGURE VIII
LEGEND:
MONTHLY AVERAGE
SUMMER AVERAGE
MINIMUM MONTHLY AVERAGE
TREND OF SUMMER AVERAGES
INTERSTATE COMMISSION OBJECTIVE
POTOMAC RIVER
FORT WASHINGTON
COLIFORM ORGANISMS
MAY — OCT. AVERAGES
COLIFORM ORGANISMS PER ML.
10,000
1,000
100
10
1
1913-14
1925
1932
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR

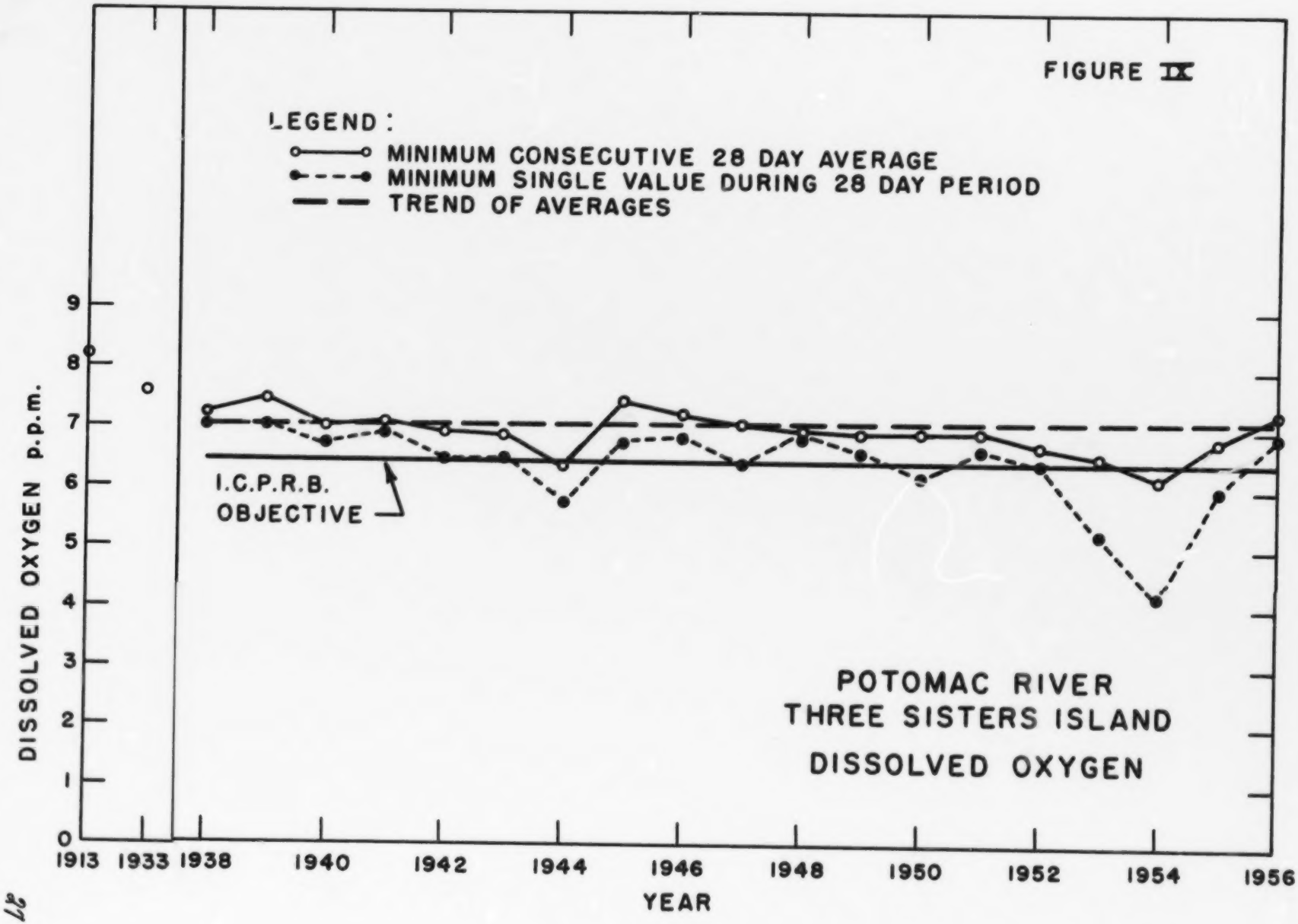


FIGURE IX
LEGEND:
MINIMUM CONSECUTIVE 28 DAY AVERAGE
MINIMUM SINGLE VALUE DURING 28 DAY PERIOD
TREND OF AVERAGES
I.C.P.R.B. OBJECTIVE
DISSOLVED OXYGEN p.p.m.
0
1
2
3
4
5
6
7
8
9
1913
1933
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR
POTOMAC RIVER
THREE SISTERS ISLAND
DISSOLVED OXYGEN

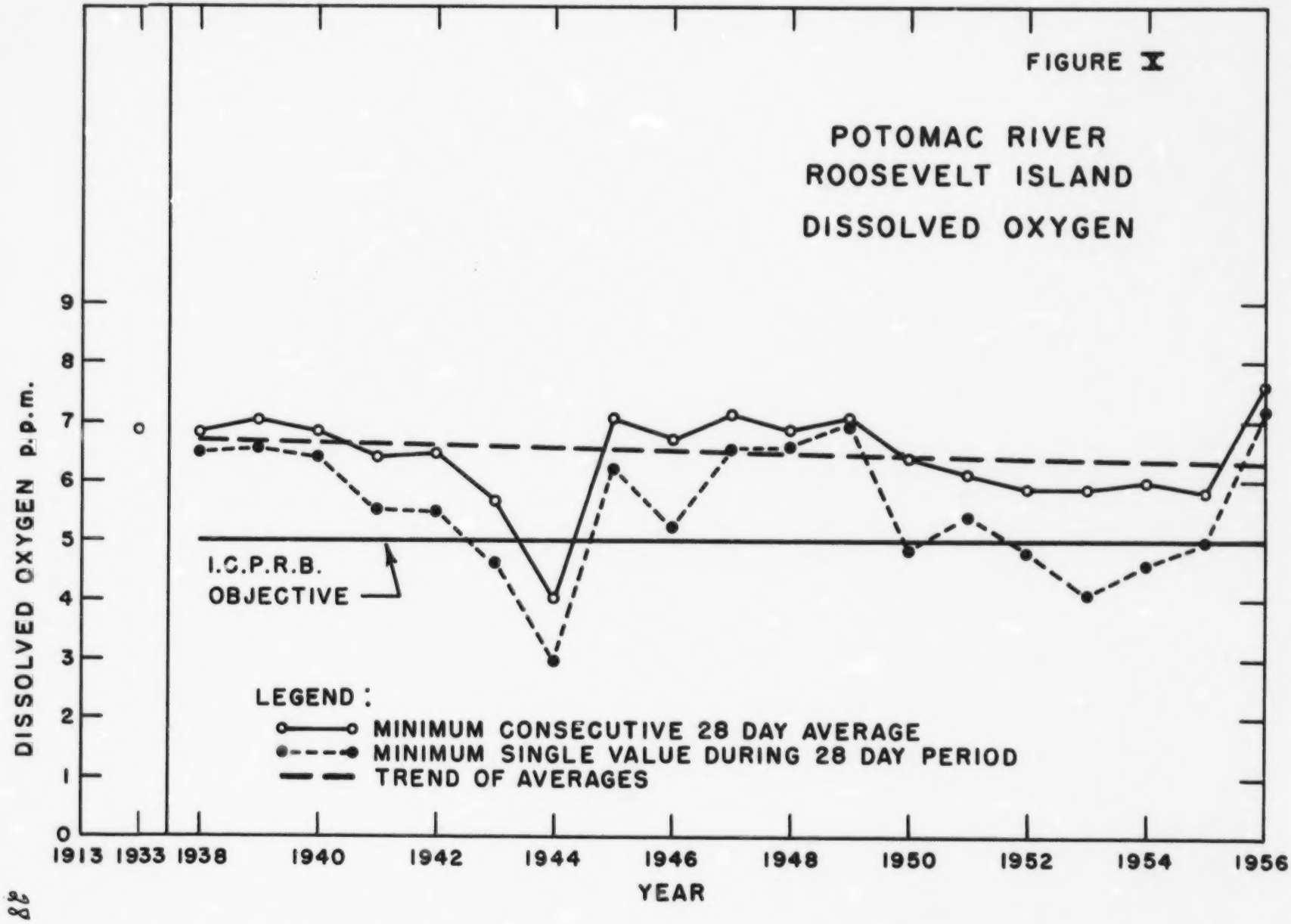


FIGURE X
POTOMAC RIVER
ROOSEVELT ISLAND
DISSOLVED OXYGEN
DISSOLVED OXYGEN p.p.m.
0
1
2
3
4
5
6
7
8
9
I.C.P.R.B.
OBJECTIVE
LEGEND :
MINIMUM CONSECUTIVE 28 DAY AVERAGE
MINIMUM SINGLE VALUE DURING 28 DAY PERIOD
TREND OF AVERAGES
1913 1933 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956
YEAR

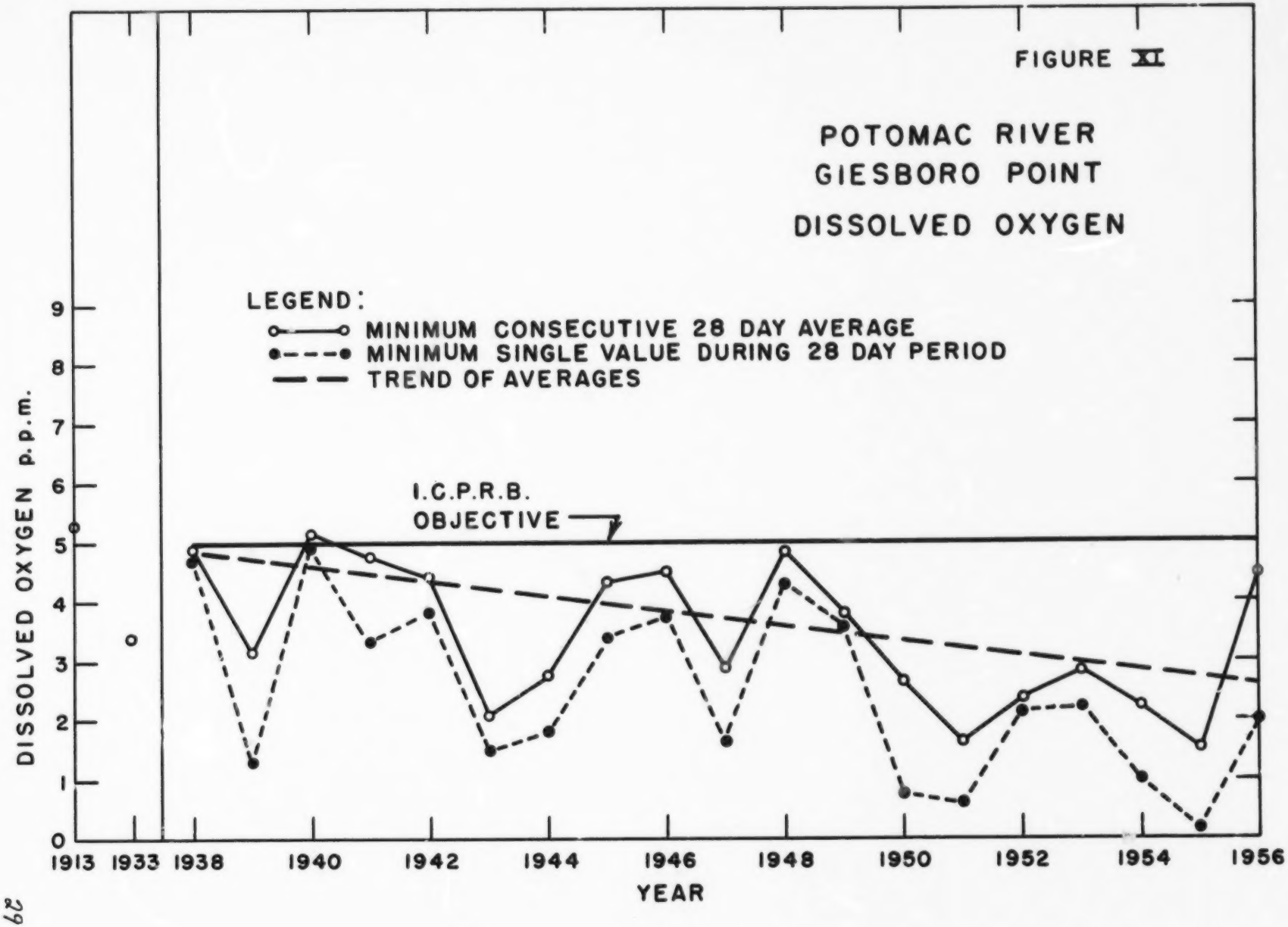


FIGURE XI
POTOMAC RIVER
GIESBORO POINT
DISSOLVED OXYGEN
LEGEND:
MINIMUM CONSECUTIVE 28 DAY AVERAGE
MINIMUM SINGLE VALUE DURING 28 DAY PERIOD
TREND OF AVERAGES
I.C.P.R.B.
OBJECTIVE
DISSOLVED OXYGEN p.p.m.
0
1
2
3
4
5
6
7
8
9
1913
1933
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR

FIGURE XII

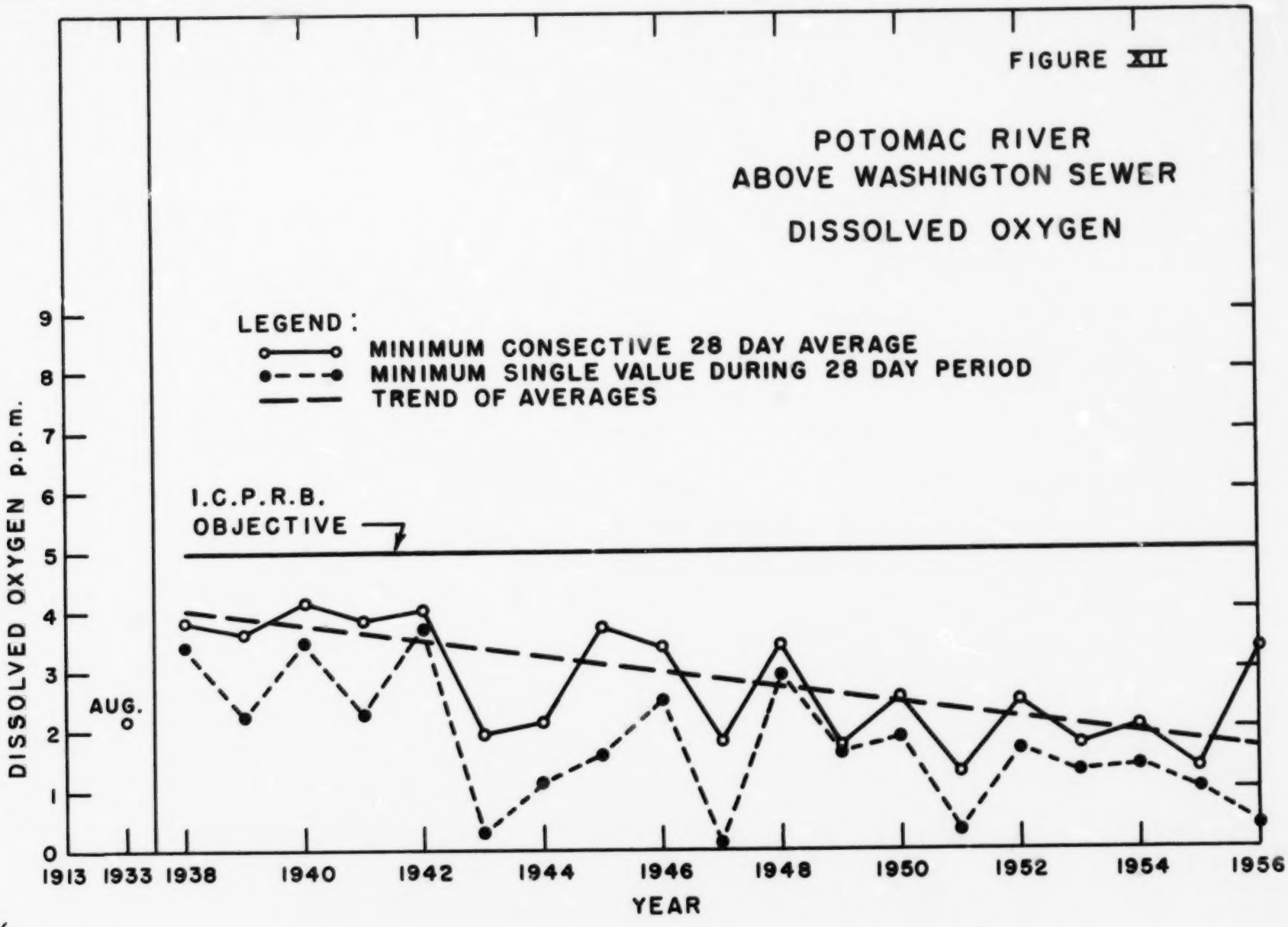
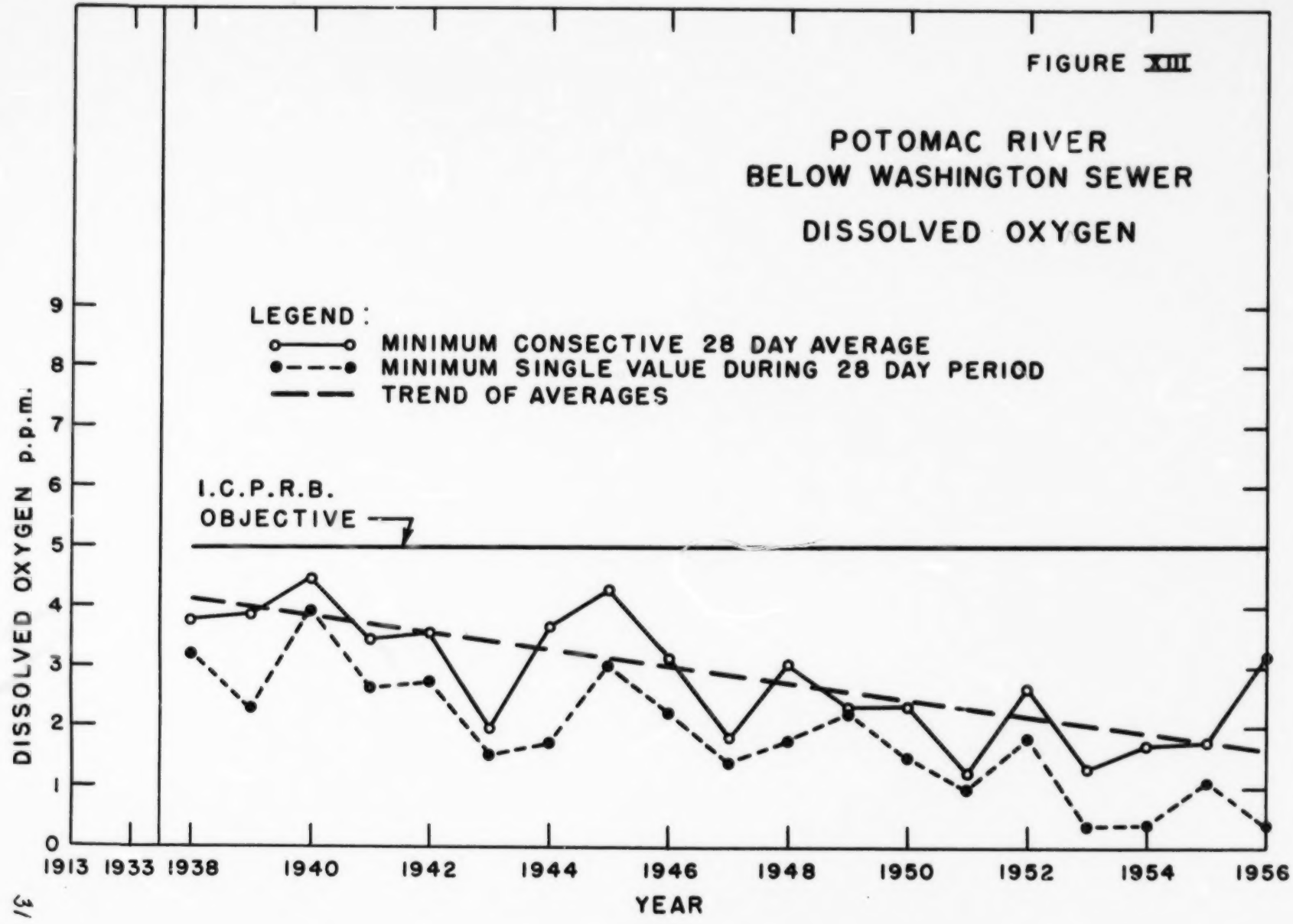
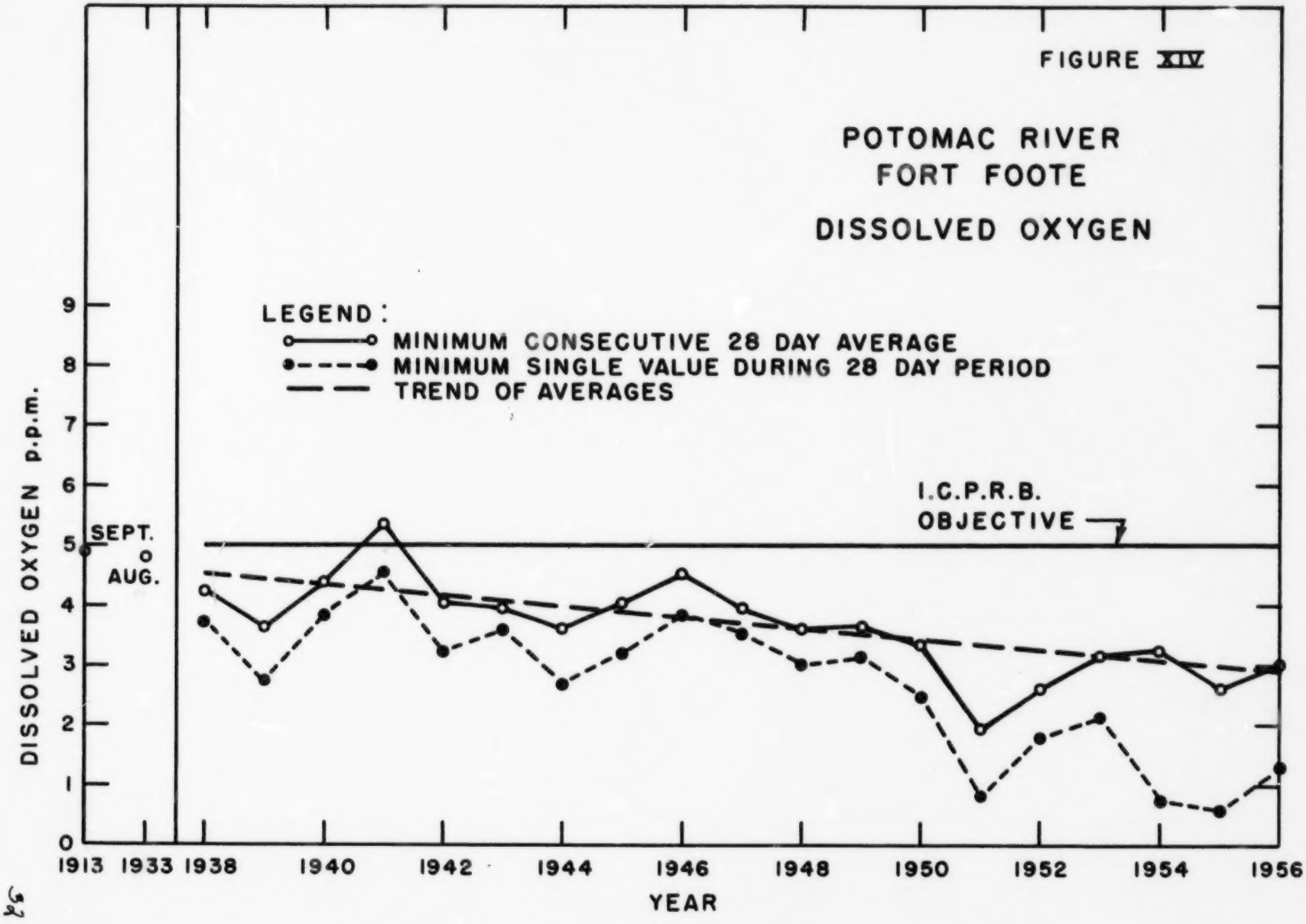

POTOMAC RIVER
ABOVE WASHINGTON SEWER
DISSOLVED OXYGEN
LEGEND:
MINIMUM CONSECTIVE 28 DAY AVERAGE
MINIMUM SINGLE VALUE DURING 28 DAY PERIOD
TREND OF AVERAGES
I.C.P.R.B.
OBJECTIVE
AUG.
DISSOLVED OXYGEN p.p.m.
0
1
2
3
4
5
6
7
8
9
1913
1933
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR

FIGURE XIII



13

FIGURE XIV


POTOMAC RIVER
FORT FOOTE
DISSOLVED OXYGEN
LEGEND:
MINIMUM CONSECUTIVE 28 DAY AVERAGE
MINIMUM SINGLE VALUE DURING 28 DAY PERIOD
TREND OF AVERAGES
I.C.P.R.B.
OBJECTIVE
SEPT.
o
AUG.
DISSOLVED OXYGEN p.p.m.
0
1
2
3
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5
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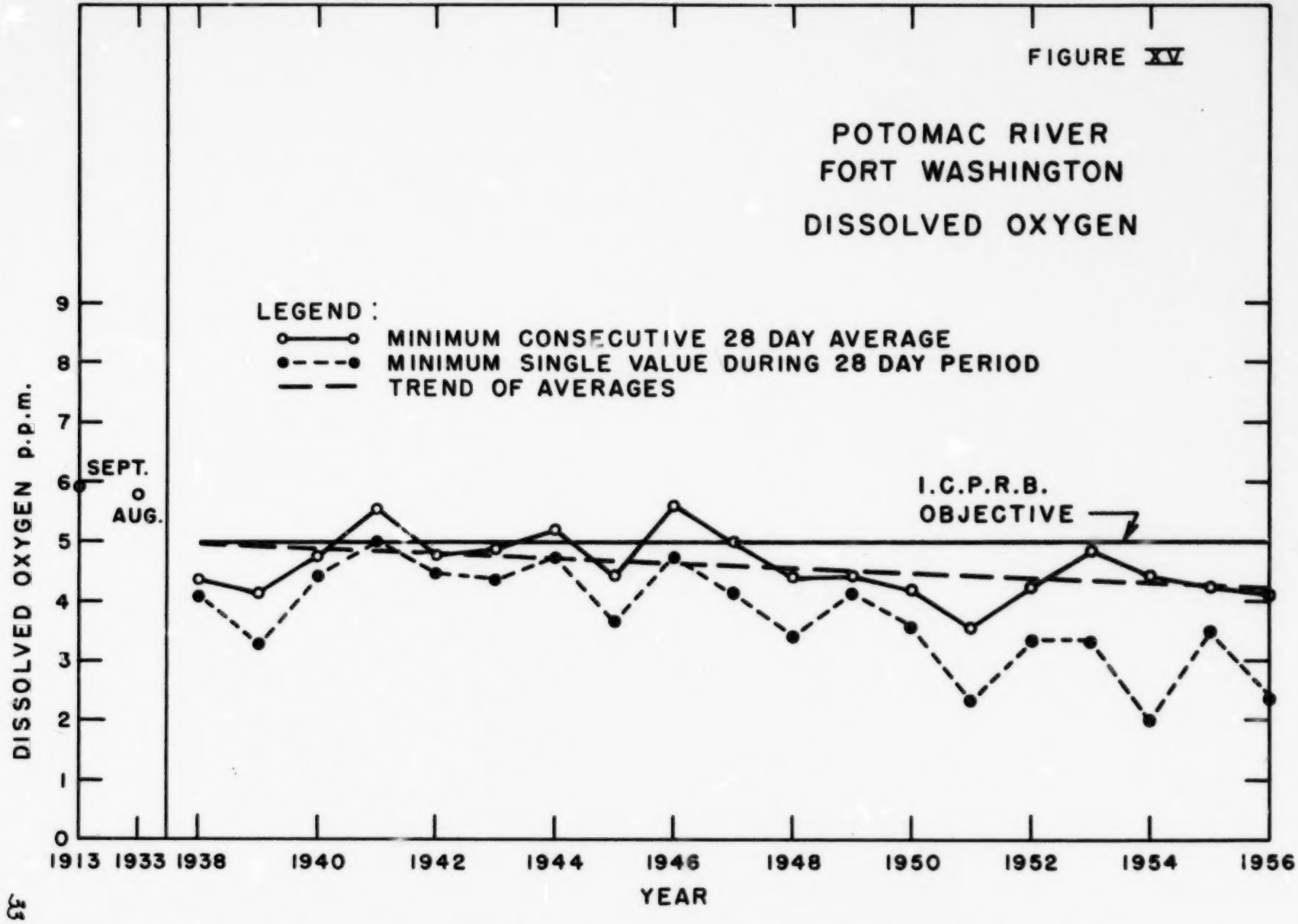
7
8
9
1913
1933
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR

FIGURE XV


POTOMAC RIVER
FORT WASHINGTON
DISSOLVED OXYGEN
LEGEND :
MINIMUM CONSECUTIVE 28 DAY AVERAGE
MINIMUM SINGLE VALUE DURING 28 DAY PERIOD
TREND OF AVERAGES
I.C.P.R.B.
OBJECTIVE
SEPT.
AUG.
DISSOLVED OXYGEN p.p.m.
0
1
2
3
4
5
6
7
8
9
1913
1933
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
YEAR

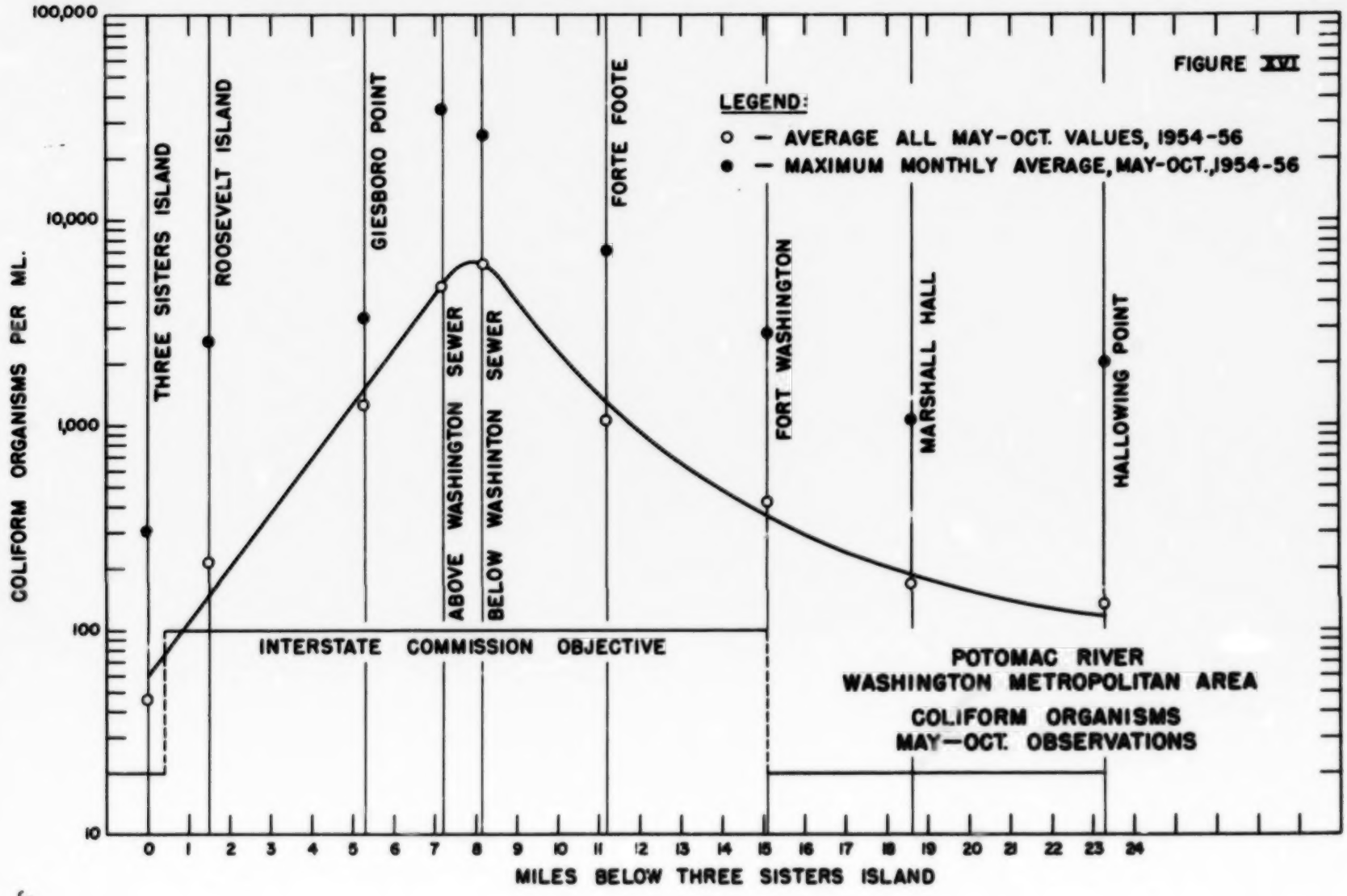


FIGURE XVI
LEGEND:
○ — AVERAGE ALL MAY-OCT. VALUES, 1954-56
● — MAXIMUM MONTHLY AVERAGE, MAY-OCT., 1954-56
COLIFORM ORGANISMS PER ML.
100,000
10,000
1,000
100
10
THREE SISTERS ISLAND
ROOSEVELT ISLAND
GIESBORO POINT
ABOVE WASHINGTON SEWER
BELOW WASHINTON SEWER
FORTE FOOTE
FORT WASHINGTON
MARSHALL HALL
HALLOWING POINT
INTERSTATE COMMISSION OBJECTIVE
POTOMAC RIVER
WASHINGTON METROPOLITAN AREA
COLIFORM ORGANISMS
MAY—OCT. OBSERVATIONS
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
MILES BELOW THREE SISTERS ISLAND

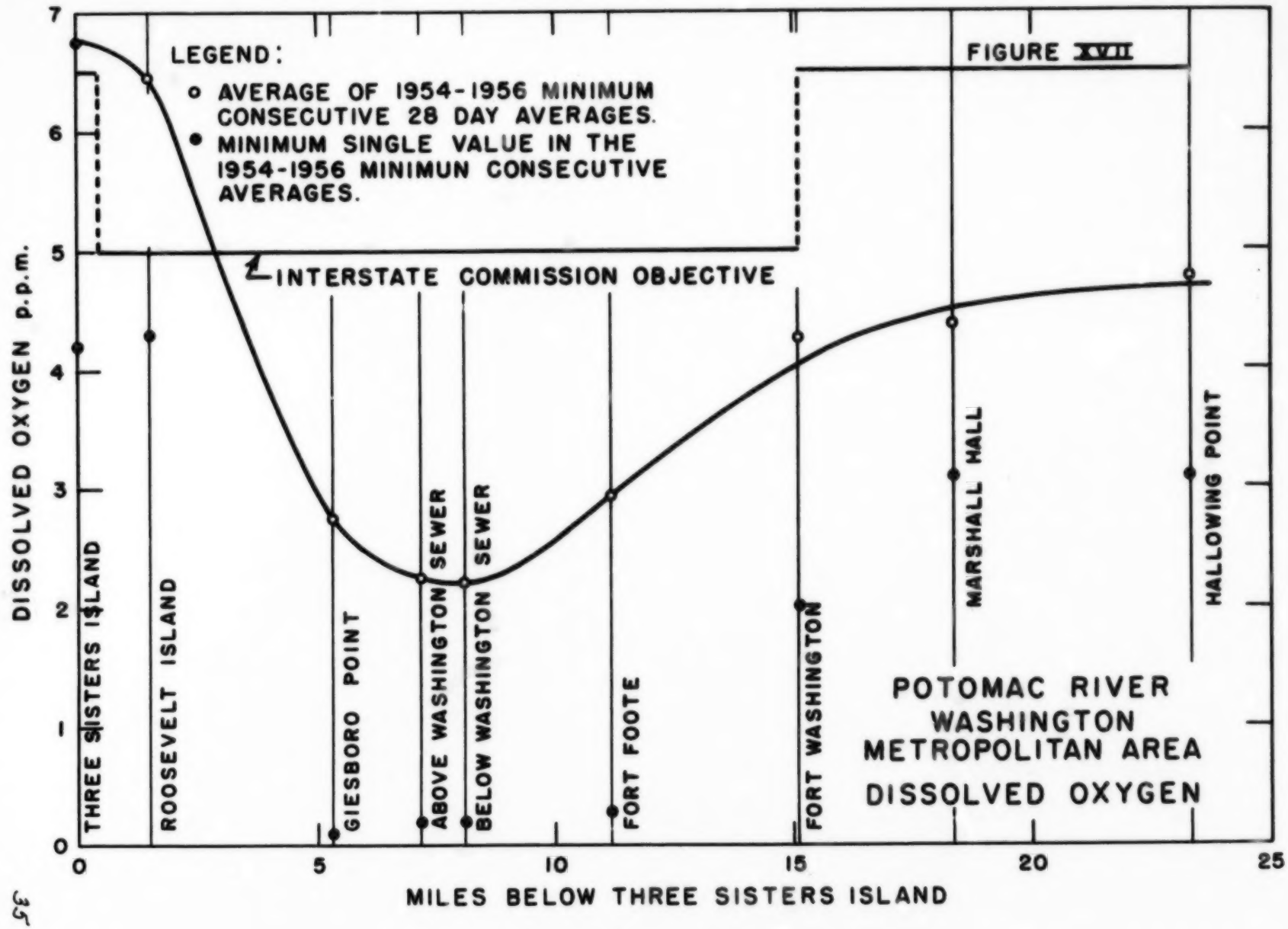


FIGURE XVII
LEGEND:
o AVERAGE OF 1954-1956 MINIMUM CONSECUTIVE 28 DAY AVERAGES.
• MINIMUM SINGLE VALUE IN THE 1954-1956 MINIMUN CONSECUTIVE AVERAGES.
INTERSTATE COMMISSION OBJECTIVE
DISSOLVED OXYGEN p.p.m.
MILES BELOW THREE SISTERS ISLAND
THREE SISTERS ISLAND
ROOSEVELT ISLAND
GIESBORO POINT
ABOVE WASHINGTON SEWER
BELOW WASHINGTON SEWER
FORT FOOTE
FORT WASHINGTON
MARSHALL HALL
HALLOWING POINT
POTOMAC RIVER
WASHINGTON
METROPOLITAN AREA
DISSOLVED OXYGEN

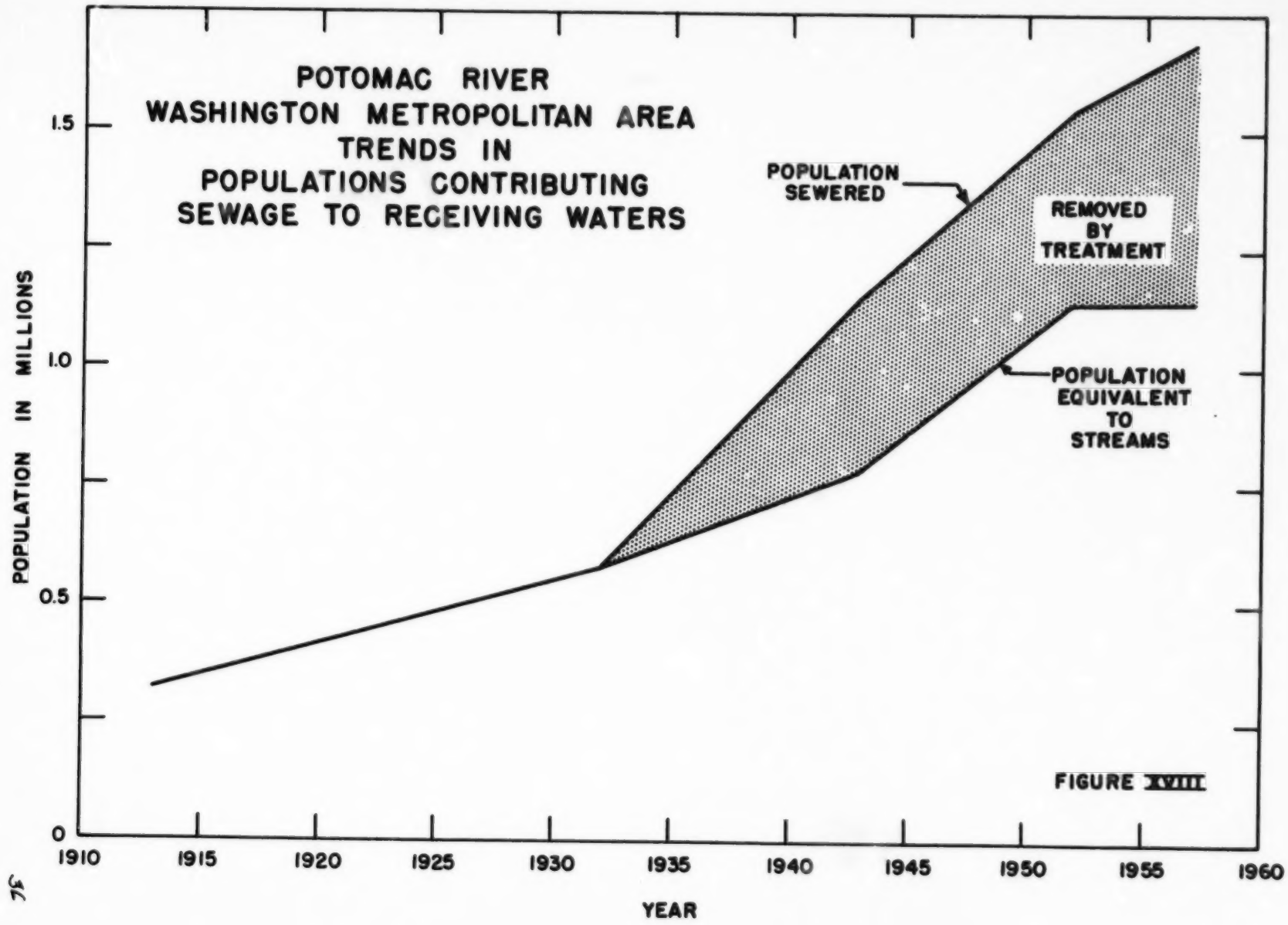


FIGURE XVIII